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Engineering News-Record

Devoted to Civil Engineering and Contracting — McGraw-Hill Publishing Company, Inc.

March 4, 1926

Building an Eight-Lane Paved Highway

Pumps, Water Softening and Filtration Plant for Bismarck, N. D., All Under One Roof

Progress of Sewage Disposal at Chicago

Analysis of Plan to Form Sixth Great Lake in Canada

Staff Report of the American Concrete Institute Meeting at Chicago

Concrete Paving Outfit
Detroit-Pontiac Highway

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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An Operating Obligation

A NEW phase of the problem of highway bridge safety is brought to attention by an accident which occurred in Washington two weeks ago, when an automobile went over the side of the old Calvert St. bridge, one of the main entrances to the city from the northwest. There have been previous discussions of the importance of strong railings and high curbs along the side of the roadway to prevent the same type of accident. In this case, however, though the curb guard was high, the vehicle rode over into the sidewalk space by the help of snow banked along the sides of the roadway, where it had been piled and packed by the sweepers which cleared the street-car tracks after a heavy snowfall some days before. It seems that except for this sweeping the deck had not been cleared of snow—a rather strange piece of neglect in the case of an elderly bridge, especially one whose strength has repeatedly been under suspicion. The case emphasizes that there is an operating side to the bridge question, whose neglect may lead to a serious accident just as much as a shortcoming in construction. To allow snow and ice to accumulate on a bridge is obviously objectionable because of the load imposed on the structure; and as the Washington case shows, there are also other reasons for making prompt snow removal a first principle in bridge operation.

A Municipal Ownership Milestone

THE Philadelphia gas works have long been by far the most notable instance of municipal ownership of that class of utilities in America—for many decades with municipal operation. Another milestone in the progress of the works has just been marked by the extension of the lease of the works held by the United Gas Improvement Co. The first lease, which will expire Dec. 31, 1927, was for 25 years. The new one is indeterminate, with the option of termination at ten-year intervals by either side. As in the first lease, so in the new one, the city gets a considerable yearly rental, which it may waive in whole or in part in consideration of lower rates to consumers—which was never done, we understand, under the present lease. Both leases afford interesting material for the study of municipal ownership of a utility, with private operation. A feature of the lease that will interest water-works men is that all service connections and meters are provided without expense to private consumers and are charged to the capital account.

Boston's New Water Supply

STRONG opposition is being voiced to the latest plan for an additional water supply for the Boston Metropolitan District and the City of Worcester, Mass. The earlier plan to go westward almost to the center of the state was also strongly opposed, even though it provided for diverting flood flows only. The new plan, reviewed in our issue of Dec. 10, 1925, p. 944, was for taking a lesser amount of water from the west and making up the difference, mainly, in Essex County, nearer Boston. Both sections are objecting so strenuously as to raise a question whether there is not likely to be another postponement of specific action by the legislature. Such delays are dangerous when consumption and safe yield are getting as close together as in the Boston district. To the legislative committee hearings now in progress there will be added on March 9 what may be termed an unofficial technical hearing at the luncheon meeting of the New England Water Works Association. On that occasion, the project will be outlined by Allen Hazen, New York City, consulting engineer to the latest investigating commission, which was headed by a prominent Boston engineer, Charles R. Gow. Presumably there will be a free-for-all discussion. A topic of more lively interest to many members of the N. E. W. W. A. it would be hard to find.

Need for Moderation

VARIOUS recent indications suggest that the public at large is developing an unusual spirit of business enterprise. The building of several large toll bridges, and demonstration that such undertakings can pay for themselves even when built from public funds, have patently whetted the popular appetite for more bridges. There is danger that the movement will overreach itself. It may be recalled that only four years ago the bridging of the Hudson by a highway crossing below Albany was still a dream, and that later on the problem of raising money for the bridge proved to be almost as difficult as was that of interesting financiers in New York's first subway. Yet the example of this first undertaking proved so contagious that even before it was completed there was under way a second bridge across the Hudson, this one a public-money toll enterprise (Poughkeepsie bridge), and other crossings are now actively under discussion. Almost identically the same thing has occurred elsewhere, and in fact a striking example is engaging attention just now. With the Camden-Philadelphia bridge over the Delaware River not yet completed, and with a serious interstate controversy about toll collection on this bridge just disposed of, proposals are made to build more bridges over the Delaware. A bridge at Burlington has been demanded, and now there is active agitation for a second bridge at Philadelphia, only a few miles below the first, presumably also for construction by public money on a toll-refunding basis. The New Jersey legislature has just passed a bill appropriating $50,000 for a survey and cost estimate for such a bridge, though there has not been any widely expressed demand for such a crossing. This is a typical illustration of the fact that

bridge projects have suddenly become popular on the strength of a blind belief that every project will pay. It is well to go slow and not be carried away by such new beliefs. It may be that the proposed new bridge would pay, and even that half a dozen bridges across the Delaware between Trenton and the Bay would be able to earn their charges; but it is prudent to wait for proof of earning power and traffic volume and other matters at issue in public toll-bridge construction before going ahead quite so fast on a mere possibility. There is no occasion for reckless haste.

Bad Estimates

MOST unfortunately, simultaneous with its impulsive action in voting money to study a second bridge at Philadelphia, the New Jersey legislature is confronted by the serious problem of finding more money —two and a half million dollars—for the Holland Tunnel and the Delaware River bridge. Both enterprises are outrunning the estimates of cost very greatly, the tunnel in superlative degree, its probable final cost being $46,000,000 while the estimated cost was $28,500,000. Only two years ago the bridge and tunnel commission received $8,000,000 more from New Jersey to supplement the original bond-issue amount of $28,000,000, which was supposed to be enough for the state's share of both structures. Yet even that supplementary estimate was twenty-five per cent too low. Unless these persistent underestimates are a case of intentionally fooling the voters for a good purpose, one of two things is true: either the estimators need a review course in arithmetic, or the efficiency of commission management is once more indicted. Probably there is more truth in the latter than in the former, yet at present the onus rests wholly on the engineers—the fact remains that their advance figures, in which the public depended, have proved deficient to such an extent that public confidence in engineering estimates is seriously weakened. To make a bad matter worse, finally, the legislature proposes to supply the two and a half millions without consulting the voters, and to do so by the devious method of dipping into highway and school funds. This is one end of underestimating.

Superhighways

THE "ideal" road was often talked of a few years ago. The thought interested the public and the newspaper press pictured it in attractive ways. There was good publicity work. Indeed a noteworthy group of engineers was commissioned to plan an ideal road. One, in fact, was built according to the plan which they developed. When it was finished all interests did not agree that it was ideal but nevertheless it was an excellent road, in many respects ahead of the then current practice or even common practice today. In its best aspect, however, this ideal road looks small beside the Michigan road described in this issue. True it is that here is a superhighway designed for super-traffic conditions but it is one of a class of roads which are becoming frequent and of which the future will see a multitude. Considering the Detroit-Pontiac road specifically, however, there is superlative magnificence in a highway 200 ft. between boundaries, with two 44-ft. pavements separated by a 40-ft. parkway. Even with today's nearer vision of the super-traffic roads of the future such a highway structure can only be occasional. That it may exist at all is a marvel, but one which is moderated by the conception of the future of the 100-mile trunkline of which it is a part. In a very few years this will be a highway graded 56 ft. wide and paved 40 ft. wide. Already the northern eight miles into Bay City being built new is under construction according to plans calling for these widths. Large as looms the eight-lane road through the suburban territory between Detroit and Pontiac the four-lane trunk line to Saginaw Bay and the resort lands to the north is a more impressive exemplification of approaching main-line highway magnitudes.

Concrete Making and the Concrete Institute

ITS GROWTH in membership from around 400 in 1920 to nearly 1,800 at the time of the convention held last week shows that the American Concrete Institute has a definite appeal, which is of comparatively recent development. The society was founded 22 years ago but after an early spurt dwindled in membership almost to extinction. Beginning about five years ago the upturn began, and the curve of membership increase since has had a steadily steepening curve.

It is interesting to note that this change took place just about the time when the laboratory studies on the proportioning of concrete were beginning to take form in practical methods, when the design of the concrete structure began to give way in importance to the necessity of producing economical, uniform, strong and durable concrete. So long as a technical society concerned itself mainly with revision of standard designs and specifications it attracted only those engineers whose predilections and practices kept them generally in the office, and the body of concrete builders were content to let these few quarrel over design detail and to take their word for the results. But when it became apparent that possibly the concrete men of the past had not learned all there was to know about the material concrete and the way it behaved, there arose a wider concern among the men who used concrete with the activities of any society that discussed such new knowledge.

The meeting last week emphasized this distinction. Few committees reported at all; no specifications of importance were proposed; design was subordinated almost to the point of elimination. The art of making good concrete was the keynote of the meeting and the four to five hundred who were in almost constant attendance—a high record for any technical society these days—was evidence that concrete men want to know how to better their product.

Whether or not the hitherto uninformed attendant at the convention was able to decide just what is now considered the proper method to proportion concrete is doubtful. There were five major papers presented on the subject, each reporting a method which the author considered successful. At bottom all these methods have a family resemblance; all depend on the proposition that just the right amount of water is of as much or of more importance in concrete than just the right amount of cement or of aggregate, but each approached the determination of the proper amount of water in a different way. A discussion of these different ways may be reserved for later. It is sufficient now to note that

the concrete builder anxious to apply to his work the latest ideas that will lead to good concrete is not going to be fully informed merely by attending one meeting or by studying one paper.

The subject is in a decided state of flux. Slowly we are approaching that hoped-for time when the welter of theories which started with the fineness-modulus and surface-aggregate controversy are to be reduced to a common denominator. One thing at the convention last week marked progress toward that end; that was the obvious simplification of the methods described over the mathematical complications of the first efforts to escape from straight volumetric proportioning. No longer is the poor concrete man who wishes to utilize his aggregate to the best advantage and to produce an economical concrete confronted with formulas and calculations formidable enough to entertain the secondary-stress expert. It is being appreciated that concrete placing, while an engineering operation amenable to engineering procedure, is generally in control of men to whom formulas and calculations are abhorrent. And the desired end of a scientifically proportioned concrete is being sought through the back door of simple tests and foolproof machinery rather than through the front entrance of complicated analysis and high priced supervision. The greater progress that is made in this direction the greater will be the distribution of good concrete.

These things the newcomers at the Institute meeting last week learned and by their interest they showed the Institute where its immediate future concern lies. Standard specifications have been rather done to death. Design is a thing for the few and the expert; it does not lend itself to open floor discussion of mixed groups. But the making of concrete comes close to many. These many are just beginning to realize that things are happening in concrete and they want to know more about them. The opportunity for service on the part of the Institute is too obvious to be neglected.

Engineer-Managers of Small Municipalities

THAT there is more than one way to get at least a considerable part of the benefits of the city manager plan of municipal administration is shown at increasingly frequent intervals. While awaiting necessary authorization by local popular vote or from the state legislature in states that are backward in this matter but have given their municipalities considerable freedom in the creation and consolidation of offices, it is both possible and feasible in many places so to increase the duties and powers of the city or village engineer as to centralize in him much of the administrative work of the municipality. Exceptions, on first thought, would be the work of the police, fire and school departments, but on reflection it will be seen that these departments have a considerable amount of engineering or closely allied work to be looked after—such as traffic control, the construction and operation of buildings and of power plants, the correlation of the fire fighting and water supply, and the construction and operation of fire and police alarm and report systems.

Our smaller municipalities are quite generally without trained administrators, and such of these as they have are largely without adequate powers. Just here is the place for the city or village engineer or for a city manager with engineering knowledge and experience, in case that is legally possible.

The advantages of such a plan have just been realized at Pleasantville, N. Y., a suburban village in Westchester County, where the voters have endorsed the manager plan and are hoping for state legislation enabling villages to appoint managers. An argument advanced by the proponents of the plan at Pleasantville was that a neighboring village—Scarsdale—had saved money by entrusting most of its administrative work to its village engineer. Where this general plan is adopted its success is dependent not only on giving the village, town or city engineer needed authority but also upon paying him amply for his work, since a man of no scanty and mean parts is essential. Scarsdale, with a population of only 3,500 in 1920, pays its village engineer $8,000 a year, it is reported.

Finally, it should be understood that making a village or city engineer chief administrative officer does not necessarily carry out the conception of the council-manager plan of government, which rests on a clean-cut separation of legislative and administrative functions—something which is not had if the village or city council multiplies the responsibilities of its engineer but does not give him a free hand in their execution, or gives it and takes it away at pleasure, as is likely to be done when the matter is not covered by the city charter, but is subject to ordinance.

Starting Anew on Cast-Iron Pipe

IN THE news columns of this issue is printed the official announcement of the formation of a new joint committee which, under the auspices of the American Engineering Standards Committee, is about to embark on the road which it is hoped will lead to a new standard specification for cast-iron pipe. It is a committee of wide interests, embracing all of those who conceivably can be concerned in the use of cast-iron pipe and of the manufacturers who serve those consumers. It starts afresh free from any of the obsessions or controversies of earlier committees on pipe standards and with the assurance, by the very nature of its formation, of full agreement before its findings can be promulgated.

Cast-iron pipe standards have been under discussion for many years but the results of the discussion have been none too happy. The consumer representatives have not been entirely satisfied that the manufacturers were going as far as they could in the improvement of methods and material to meet the highest grade requirements. The manufacturers, on their side, have felt that their product was satisfactory to the overwhelming majority of consumers and that a finicky few were demanding some academic refinements which would measurably increase cost of production without appreciably benefitting the product. Meanwhile competitors to cast-iron pipe have come into the field and are growing in use. It is to the interest of the producer so to standardize his product as to reduce the competition of these other materials, to satisfy as nearly as he can the demands of the user. It is to the interest of the consumer not to demand so high a quality of product as to make the cast-iron pipe beyond the range of competitive use. If this new committee can compose these two interests it will deserve the thanks of both the consumer and producer.

Building An Eight-Lane Paved Highway

Two 44-Ft. Concrete Slabs in a 200-Ft. Right-of-Way Being Constructed to Carry Traffic Averaging 14,000 Vehicles in 24 Hours and Having Peak Days of 21,000 Cars

APPROXIMATELY 13 miles of super-highway is well advanced in construction continuing Woodward Ave. out of Detroit, Mich., from the Wayne County line to Pontiac. Parallel 44-ft. pavements separated by a 40-ft. strip for electric railway tracks, all within a 200-ft. right-of-way, are being built. Last year the construction was over half finished and this year it is planned to complete the road. It is without question one of the notable highways of the world and one of the most expensive of highways which are not urban streets or viaduct and tunnel structures. Woodward Road is through suburban territory, well built up or under development, but having no excessive property values and offering no exceptional physical obstacles to construction. Indeed construction is straight-forward paving and grading complicated only by extraordinary width and dense traffic.

Location and Traffic—Woodward Ave. is a main traffic thoroughfare of Detroit and is also a part of state trunk line road 10 from Detroit through Pontiac, Flint, Saginaw and Bay City, and north to where it forks into several roads going to the resort and camping districts north of Saginaw Bay up to the Straits of Mackinac. The location is shown by Fig. 1. Besides the tourist traffic there is a heavy industrial traffic between Detroit, Pontiac, Flint and Saginaw, all centers of motor vehicle production. In short, there is scarcely a state highway in Michigan of greater existing and potential traffic importance. It has been paved from Detroit to Saginaw—all 18 ft. and 20 ft. concrete. Now the super-highway is being put in from Detroit to Pontiac, and an extension from Saginaw to Bay City, a 40-ft. pavement on hydraulic fill, is under construction.

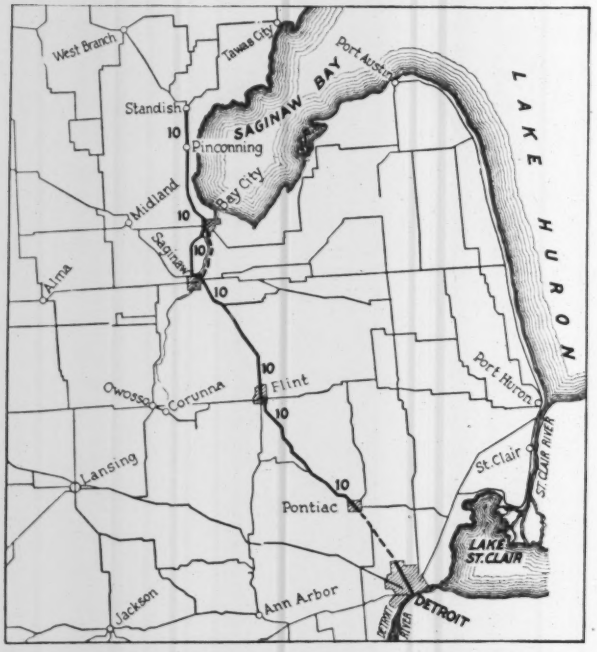


FIG. 1—MICHIGAN TRUNK LINE ROAD TEN AND CONNECTIONS

This heavy traffic route through the automobile cities of Detroit, Pontiac, Flint and Saginaw is the location of two of the most notable road building operations of the country: (1) two 44-ft. pavements in a 200-ft. right-of-way from Detroit to Pontiac, and (2) a 40-ft. pavement on a hydraulic fill from Saginaw to Bay City.

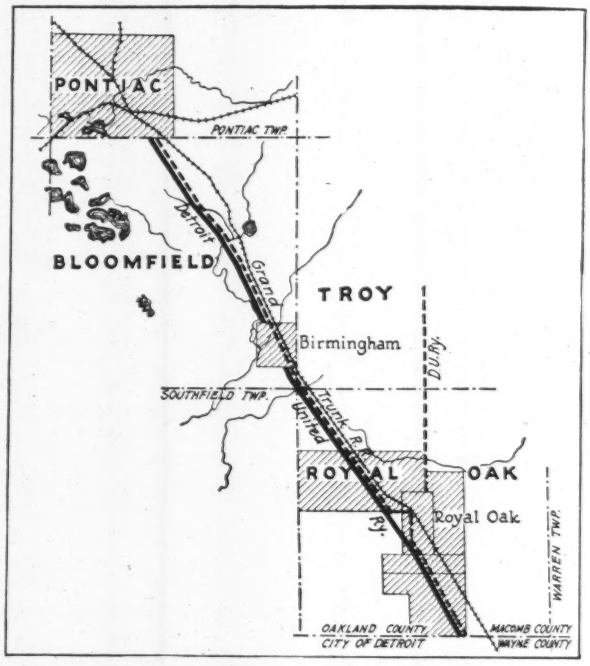


FIG. 2—LOCATION MAP OF DETROIT-PONTIAC ROAD

The road to Pontiac had originally an 18-ft. concrete pavement built about ten years ago. The old right-of-way was nominally 100 ft., but property owners had crowded out onto the road space until in some places it was less than four rods wide. There was a double-track trolley line, and electric service poles of various sorts were in the right-of-way, besides the 18-ft. pavement. With the pavement, a not inconsiderable improvement for its time, the home seeker and promoter of subdivisions took over the farm lands and the little villages became sizeable towns. Coincidently there came the astonishing industral growth of Detroit and its tributary cities. Traffic increased tremendously. On peak days it reached 21,000 vehicles in 24 hours; the average number was 14,000 daily. The congestion became unsupportable and improvement was decided on.

Action was inaugurated by the road commissioners of Oakland County bordering Wayne County on the north and containing the city of Pontiac. They prepared surveys and plans and sought state action. This was not possible until in 1923 the state legislature passed an enabling act for financing and widening. That same year Governor Groesbeck ordered the work to go ahead. Right-of-way negotiations and the preparation of plans occupied virtually all of 1924, and actual con-

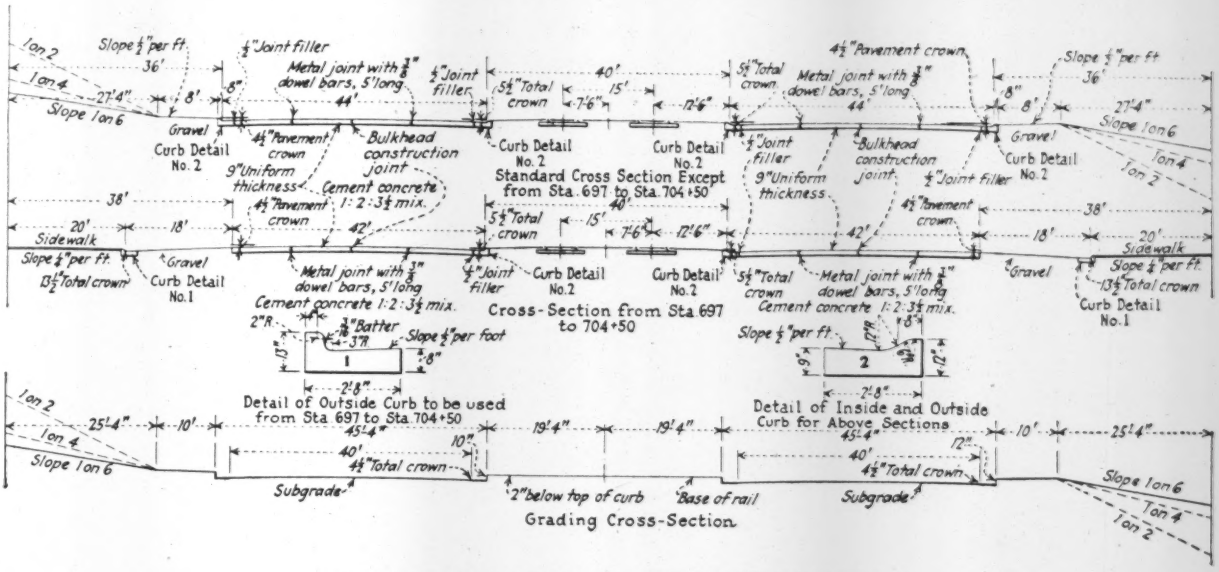

Standard Cross Section Except from Sta. 697 to Sta. 704+50
Cross-Section from Sta. 697 to 704+50
Detail of Outside Curb to be used from Sta. 697 to Sta. 704+50
Detail of Inside and Outside Curb for Above Sections
Grading Cross-Section
Curb Detail No. 1
Curb Detail No. 2
Gravel
Sidewalk
Subgrade
Base of rail
2" below top of curb

FIG. 3—CROSS-SECTIONS OF DETROIT-PONTIAC ROAD

struction was begun in 1925. The location adopted was a substantially direct line as shown by Fig. 2, in which are to be noted the trolley line in the road right-of-way and the closely paralleling Grand Trunk Ry.

Road Plans—Not including the section in the village of Birmingham, the new road as shown by Fig. 2 is 13.2

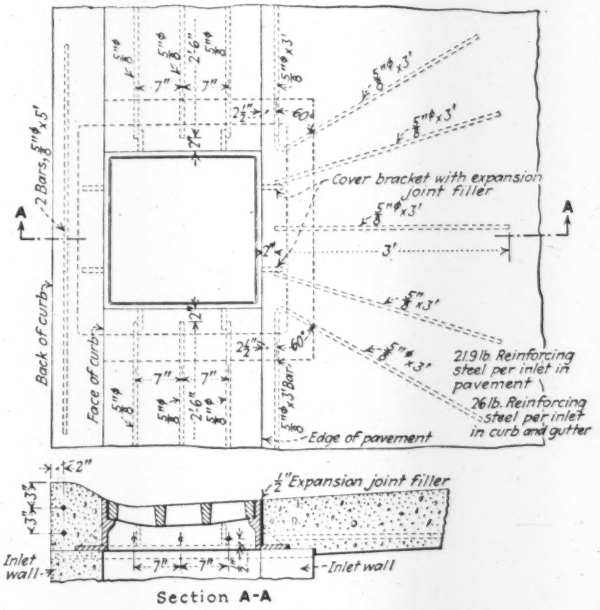

Cover bracket with expansion joint filler
2 Bars, ⅜" x 5'
Back of curb
Face of curb
Edge of pavement
21 lb. Reinforcing steel per inlet in pavement
26 lb. Reinforcing steel per inlet in curb and gutter
½" Expansion joint filler
Inlet wall
Section A-A

FIG. 4—CATCHBASIN CONSTRUCTION

miles long. The maximum curve is 1 deg. and the maximum grade is 6 per cent. Fig. 3 shows the grading and paving cross-sections. The same paving cross-section is used throughout except for 7½ stations as noted. It is important to note the allotment of the 200-ft. right-of-way space between paved roadway, shoulders, sidewalk and center strip for trolley tracks. In this center strip are all pole lines; conduits provide for service lines elsewhere. Thickness, material and structure of pavement are shown by Fig. 3. Each roadway has four traffic lanes marked by joints as indicated. The curb construction, to make it easy for vehicles to cut out onto the shoulders, is to be observed.

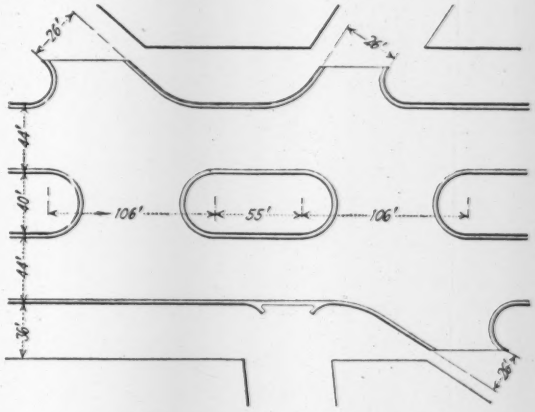


FIG. 5—MULTIPLE INTERSECTION, DETROIT-PONTIAC ROAD

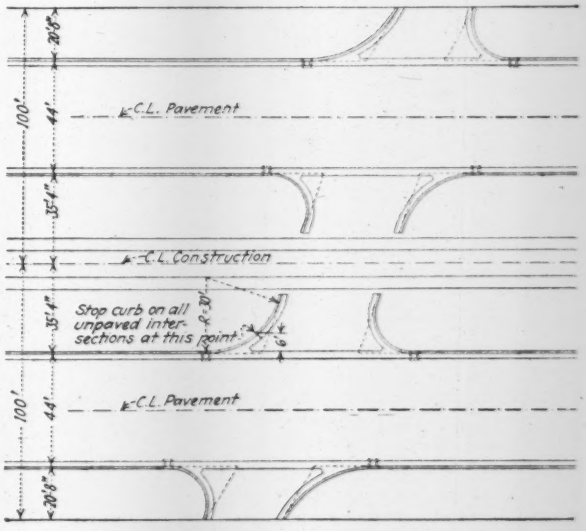


FIG. 6—STANDARD INTERSECTION DESIGN

Drainage and intersections, however, furnished special problems. Subsurface storm drains carry all drainage into community sewers and county drains. These road drains range from 12-in. to 36-in. pipe and are provided with catchbasins of heavy design as shown by Fig. 4. As the drains were completed ahead, they were tried out by some very heavy rains during paving operations and appear capable of clearing the road of water as fast as it comes. As perfect drainage as possible was sought to reduce frost action. Fig. 6 shows catchbasin locations. All crossing roads are at grade. A typical intersection plan, with crossover is shown by Fig. 6. In general cross-overs have been put in at about every third intersection. At multiple intersections, as at Lafayette Ave., Fig. 5, a full-paved plaza with a safety island is employed.

A view of one of the completed 44-ft. pavements is shown by Fig. 7. Ultimately the road will be fully landscaped. For the most part, however, it now passes developed subdivisions and large estates where roadside attractiveness has been sought, and so presents a good appearance at the beginning.

Construction Methods—There were no unusual methods of construction employed and no conditions which imposed unusual difficulties. There were, however, many complexities of procedure due to widening and right-of-way. These were mostly in the grading operations. In 1925 operations were concentrated on the west strip of pavement and this was completed its full length except through the village of Birmingham, where there is already a wide pavement and it was necessary to delay full widening for right-of-way adjustments. Besides completing the west pavement, all the grading, except five miles where the Grand Trunk Ry. blocks operations until it is shifted east to a new right-of-way, was finished.

Grading was done by steam shovels and trucks. There was one heavy cut just south of Pontiac and in two places swales with muck bottoms had to be crossed. The solid fill was put onto the muck, crowding it aside and sinking to solid bottom. Widening went on with the grading and made a fussy task of cutting down and restoring property frontages, setting back buildings, taking out parts of cemeteries. All this work had also to be done with one trolley track in operation and with road traffic going on. This involved cut-overs, cross-hauling and piecemeal track shifting and all kinds of adjusting and changing, though no real difficulties. The only special task of grading was the removal of the old concrete road. This was broken up as shown by Fig. 8. With the slab cut into strips, it was ripped up and hauled away by shovel and truck, Fig. 9.

In paving the curbs were put in ahead and the concrete was placed in two 20-ft. strips using standard 21E pavers, industrial railway haulage, central proportioning plants and machine tamping. A typical outfit at

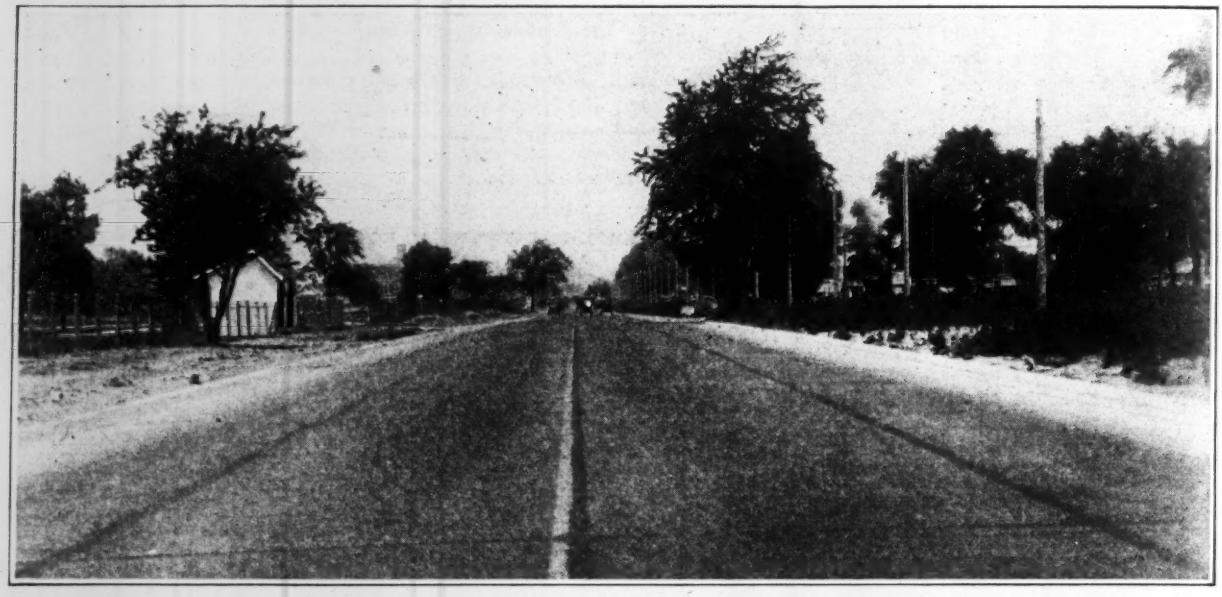


FIG. 7—FINISHED 44-FT. STRIP OF DETROIT-PONTIAC ROAD

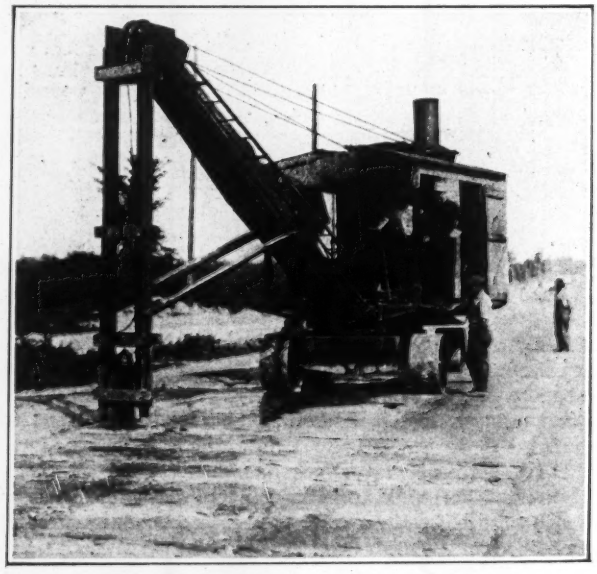


FIG. 8—BREAKING OUT OLD PAVEMENT

work is shown by Fig. 10. All paving conformed to Michigan state road standards, 1:2:3½ concrete; 9-in. slab; doweled center joint; ½-in. expansion along curbs and every 50 ft. transversely. As will be noted from Fig. 3, the joint between the two 20-ft. strips is a plain construction butt joint. Last year one 44-ft. strip was paved as stated and this year it is planned to complete the other strip.

The contracts were divided. For 3.4 miles north from the Wayne County line the contractor was the R. D. Baker Co., Detroit, Mich., and the quantities were 105,346 cu.yd. of grading and 168,162 sq.yd. of paving. From this contract north 4.24 miles contract for the west 44-ft. strip only was let to the W. H. Knapp Co., the quantities being 103,300 sq.yd. of paving and 33,333 cu.yd. of grading. The remaining 5.516 miles to Pontiac was let to the White Co., Milwaukee, Wis., for paving 171,800 sq.yd., and to George Smith Co., Detroit, Mich., for grading about 200,000 cu.yd.

FIG. 9—GRADING SHOVEL AND TRUCK

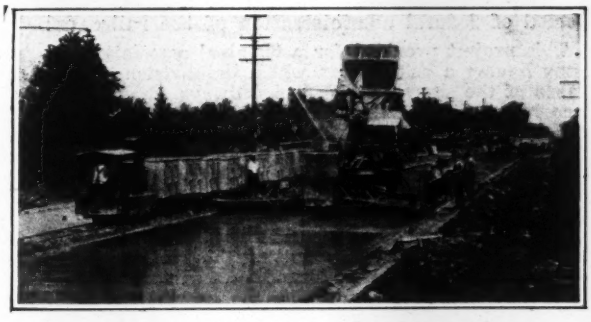


FIG. 10—CONCRETE PAVING OUTFIT, DETROIT-PONTIAC ROAD

The road is being built under the direction of the state highway department, F. F. Rogers, commissioner; G. C. Dillman, deputy commissioner and chief engineer; Leon V. Belknap, project engineer; and A. M. Comb, asistant engineer.

Glacier Water to Be Used at Boulder, Colo.

The acting city manager of Boulder, Colo., has been instructed by the city council to purchase from the United States Government the land occupied by the Arapahoe glacier in order that it may be used to supplement the city's water supply. The glacier is about 15 miles from the city.

Improvement of Fire Service and Quality of Keene Water Supply

WITHOUT any change in source the fire hydrant service of the water supply of Keene, N. H., has been improved in pressure and increased in possible volume at Central Square from 1,500 to 4,000 g.p.m. at 60 lb. pressure or 2,900 g.p.m. at 75 lb. pressure and at the same time the quality of the water has been materially improved. This was accomplished, according to a paper read by Robert Spurr Weston and G. A. Sampson before the New England Water Works Association on Jan. 12, by cleaning two old supply mains, putting in a controlling-altitude valve on one of the mains, building a new service reservoir, laying a supply main from it to the distribution system, reinforcing the latter, and building covered slow sand filters.

In a report made Aug. 5, 1922, Prof. H. K. Barrows, consulting engineer, Boston, advised in substance most of the improvements since made, but did not propose filtration, the need for which had not yet been shown. Fire stream tests made by him showed deficient hydrant pressure and volume; also that a 12-in. supply main laid about 1902 had only some two-thirds, and an 8-in. laid in 1886 only a half the carrying capacity of new pipe lines. On cleaning the 8-in. supply main its carrying capacity was increased from 0.538 to 0.914 m.g.d.

The reason for putting in filters was an outbreak of gastro-enteritis in October, 1923, after the date of the Barrows report. This outbreak was investigated by the late Prof. George C. Whipple and the authors of the paper here abstracted. Although the cause of the outbreak was never conclusively determined, the evidence pointed to the Roaring Brook supply, even though it had a resident population of only four people on its 6 sq.mi. of drainage area. This source is practically without storage and "subject to accidental contamination from men and animals," the authors of the paper state. They also state that "careful inquiry" showed that northern New England towns "supplied with natural water from upland sources," frequently have gastro-enteric disturbances in the fall of the year.

These facts, combined with a color ranging from 10 to 60 p.p.m. and averaging 30, and lack of reservoir site affording long storage, led to the adoption of filtration for the Roaring Brook supply, which is delivered through two supply mains. Difficulties of attendance in bad weather "which helped decide against chlorination also led to the recommendation of slow filters rather than rapid filters using chemicals for treatment." Hydraulic conditions required two purification plants, one for each supply main. The plants have areas of 0.147 and 0.289 acre respectively. Both filters as well as the new service reservoir have their reinforced-concrete roofs covered with earth to a depth of 18 inches.

Unification of Railway Freight Terminals

Comparisons of Multiple-Unit System with a Series of Independent Parts—Examples of Experience—Interchange Service—Railway and Public Interests Involved

By E. E. R. Tratman
Associate Editor, *Engineering News-Record*

THAT terminal operation represents a large proportion of the time and cost of freight transportation, and that material increase in efficiency with decreased cost may be effected by improvement in terminal operation, are principles now so generally recognized as to be axiomatic. In consequence, all important railroads have been spending great sums on new and improved terminal facilities. Futhermore, it is generally admitted that co-operative action is an important means of combining efficiency and economy. But projects for co-operative use of the terminal facilities of different railroads at given points, or their operation as a unified or multiple-unit system under a single management, rather than as a number of independent and separately managed parts, are not regarded favorably as a rule by railway officials. This attitude appears to be due in part to a preference for individual or independent action and to a natural desire for the retention of any advantages in a competitive business, but there is also an underlying opinion that movements for such co-operation might result in public or municipal demands for costly and extensive improvement of railway terminal facilities.

Attempts to introduce unit operation at specific points are bound to meet with difficulties, since a road having good facilities or location will naturally object at first to sharing its advantages with competitors who may be handicapped by facilities which are inadequate or poorly located. But in the long run the first road would probably benefit from having taken the broader-minded attitude of co-operation. In addition to possible benefits in quicker interchange of cars and consequently quicker transportation, together with reduced terminal costs, there is the very practical possibility that the second road may at some time rehabilitate its facilities or build anew, and thus perhaps gain an actual advantage over its competitor. Furthermore in these days of demand for high efficiency and economy there is much more to be gained by compromise and co-operation than by insistence upon exclusive rights and privileges.

Apart from the moral aspect of co-operation, however, there is the physical aspect that existing trackage and facilities of different railroads at any one point may not be adapted for combination in a unit terminal system. Freight terminals in large cities are likely to present a complicated problem in unification, owing to their number, their usually unsystematic arrangement, and perhaps to topographical conditions. Each case would be a distinct problem in itself. Even where complete combination of all terminals into one unit system is impracticable or undesirable, there may be opportunities for co-operation which will not only improve railway service but also relieve congestion of city traffic by better distribution of teaming routes. As a rule, unification of terminals has been considered almost exclusively in regard to railway interests, with little consideration of interests or conditions outside the terminal, although it is obvious that these several interests are mutual in many respects.

Union Freight Stations—One phase of co-operative railway work which has been carried into practice is the establishment in several cities of large and well equipped joint or union freight stations, where freight for numerous roads is received and distributed, thus reducing the amount of teaming of freight to various stations and reducing the cost of freight handling. Development of a complete unified terminal system might necessitate the abandonment of certain facilities, joint use of others and construction of connecting links. To quote from a paper on "Improvements in the Handling of L.C.L. Freight at Large Cities," published in the *Bulletin* of the American Railway Engineering Association in 1922:

> There would be a leveling down of some favorable competitive advantages, but also the abandonment of superfluous or inconvenient facilities and a leveling up of unfavorable conditions. The net result probably would be beneficial to the public and the city and to the transportation of freight, which result would react to the advantage of the railways.

An interesting example of the possibilities of terminal unification on a large scale is given in the paper noted above, in regard to a project worked out by a board of engineers at Cincinnati during the World War period of federal administration of the railroads:

> This project provided for a terminal association or company having a belt line on which the division or terminal yards of the several trunk line railways would be located. The jurisdiction of the individual lines or divisions would end at these yards, all movements over the belt line and within its boundaries being performed by the terminal company. This company was also to operate a union passenger station and a central freight station having team trucks and warehouse facilities. Store-door service was to be included, partly to insure prompt loading and unloading and release of cars by putting this work under control of the terminal company (organized in the interests of the railways) and thus eliminating the general use of freight cars for storage purposes. In the revised track layout all grade crossings of streets or railways were avoided.

Experience During the War—Under government administration and operation of the railways as a national and unit system during the World War, this matter of increasing efficiency by unification of terminals became of very great importance and the system was put in force at several cities. Each terminal district had one administration head, as would be the case for a unified terminal established under present conditions and serving a number of competitive or non-competitive lines. In the main, the results were distinctly satisfactory as to lower cost of service and more rapid movement of both local and through freight. At one point, terminal detentions were reduced 50 per cent, while at another point the time of movement of cars to and from industries and freight houses was reduced by 24 to 96 hours. These same advantages would result with privately owned railroads served jointly by a terminal

organization. Their direct application to shippers and consignees of freight as well as to railways transporting freight, is very evident.

A.R.E.A. Report—Special study of the problem of unified operation of terminals under war conditions was made by the Yards and Terminals committee of the American Railway Engineering Association. In a preliminary report, in 1918, the committee stated that investigation would benefit both the general situation and the individual roads. It pointed out that while pronounced advantages may be secured by pooling or unifying existing facilities, there may be situations demanding large expenditures and obliteration of exclusive interests—surrender of individual properties and the merger into a terminal company or association of all facilities in the terminal zone. This committee later issued a lengthy review of unit operation at numerous terminal points, indicating the results obtained.

As to the operation of the unified terminal facilities at any point, the report pointed out that the load should be distributed evenly among all units, so as to secure their constant normal use at the most intense efficient rate, avoiding excess peak load on any unit and treating both the individual unit or facility and the unified terminal as a part of the railway system. With the return of the railways to individual ownership and the resumption of competitive business, there was a relapse from the broad-minded attitude indicated by the reports and although the subject of unification of terminals was referred to the committee for several succeeding years it received no further attention.

Municipal Aspects—For the establishment of a unified terminal system at any point, the report of the above committee suggested that investigation and recommendation should be made by representatives of the local transportation, engineering, mechanical and traffic departments of the railways concerned. In the case of large terminals, such a committee would be enlarged by similar representatives from other points, thus insuring a broader view of the local situation. It will be noticed that no reference was made to public or municipal representation. But the public provides the freight to be handled, the city provides streets serving the terminals, and the general terminal business closely affects and is affected by street layouts, traffic routes and other local conditions. For these reasons, experts representing the community certainly should be included in any board or commission having to consider a terminal unification plan. In fact, it would be wise for the railways to request the appointment of such outside representatives, and thus avoid possible objections and criticisms on the part of public authorities after the railways have prepared their plans.

In spite of the generally repressive atmosphere already noted, the problem of unification of terminals persists in cropping up periodically for consideration from the municipal, railway or shippers' point of view, or in regard to its purely economic aspects. The principle has its supporters, of course, in railway circles, and in a recent address by T. C. Powell, president of the Chicago & Eastern Illinois R.R., it was put forward as promising advantage to both the public and the railways. His argument centered largely on freight car movements. According to Mr. Powell: "In certain cases, the total of the various switching charges in the movement of individual cars from one industrial zone to another is greater than the tariff rate provided for such service and collected from the shipper. In this way, the terminal handling of some cars is an actual loss to the railroad responsible for their movement."

Interchange Service—A further argument in favor of unification is that multiple switching operations result in discrimination, since interchange of cars between industries on the same switching road is made at a single service charge, while for industries on separate switching roads the charge is higher, for the reason that the cars pass over two or more railroads. An advantage noted at one of the War unit terminals was that it served all freight stations, warehouses, docks, and industries in that district. Previously, some of these facilities were served only by one or two of the several railroads, necessitating numerous interchange movements, with consequent delay, and involving much expensive switching for small shipments.

This transfer and interchange service is a serious matter at terminal points having several railroads, some of which may have no physical connection with each other except over the rails of a belt line or switching road. Where each road handles its interchange service with its own engines and crews there is not only a heavy aggregate expense but there is serious loss of time consumed in moving a car from an inbound train on one road to an outbound train on another road. Such delays are cumulative for cars passing through numerous terminals of different roads on long trips. If this service for an entire unified terminal was handled by a single organization, the work could be done with fewer engines and switching movements, less switching mileage, and lower cost of terminal service. Further, the transfer from inbound to outbound points would be made in less time, with the ultimate result of reduced cost of transportation and reduced time in the movement of freight from shipper to consignee.

The larger the number of railways involved at any one point, the greater is the complication of the problem. That the difficulties are not insuperable—and perhaps are not as serious as they sometimes appear or are assumed to be—is shown by the fact that there are a number of terminals more or less unified, while definite plans have been prepared for others. The case of Cincinnati has been mentioned already. In a project put forward for Chicago, and described in *Engineering News-Record* of July 13, 1922, p. 59, the position was taken that although unified control and operation would be necessary for the effective use of the proposed plan, such control need not involve disturbance of ownerships, since single or unit administrative control could be secured by lease or operating agreement.

St. Louis Case—A comprehensive example of unification is that of the Terminal Railroad Association of St. Louis, which is composed of 15 trunk lines and serves 28 railroads and about 1,100 industries on both sides of the Mississippi River. In addition to the union passenger station, used by all the railroads, the association provides extensive interchange freight yards, l.c.l. freighthouses, team yards for carload freight and other facilities which supplement the terminal yards and facilities of the individual roads. A statement by Henry Miller, president of the association, shows that during the past year about 2,500,000 cars were interchanged, while solid trains of special through freight were transferred frequently from one line to

another. Transfers are made on regular schedules to insure delivery of cars in time to be forwarded in connecting trains. It is obvious that if all this complicated interchange was handled by 15 or 28 railways there would be excessive cost and intolerable confusion and delay.

On a smaller scale is the Kentucky & Indiana Terminal R.R., of Louisville, Ky., the capital stock of which is owned by the Baltimore & Ohio, the Southern and the Chicago, Indianapolis & Louisville railways. It has some 70 miles of line, with a bridge over the Ohio River and facilities on both sides of the river. Each railroad owns and operates its local freighthouses, but it is easy to see that these could be used as (or replaced by) joint freighthouses as part of the unified system. All freight traffic for the three roads is handled by the terminal company, which also maintains their freight and passenger motive-power and car equipment, billing them monthly for all costs incident to such maintenance. Furthermore, the company does the classification work in making up outbound freight trains for the three roads and distributes all their inbound cars to connections or local industries.

Again, at Portland, Me., the Portland Terminal Co. owns all steam railroad properties within the limits of Portland, South Portland and Westbrook, with the exception of those of the Canadian National Railways. The Boston & Maine R.R. and Maine Central R.R. are tenants using the tracks, passenger and freight stations, yards and engine terminal. All switching and transfer service is handled by the terminal company.

In general, it appears that the unified terminal presents direct advantage to the three-fold interests of the railway, the city and the public. There are, of course, many difficulties to be overcome and more or less expenses to be provided for, but such unification is evidently a means toward insuring that high efficiency and economy of transportation for which the railways are striving.

Measuring Glacial Movement on Mount Hood

Markers Located by Transit Where Glacier Has Width of 2,400 Ft. Show Maximum Summer Flow of 7½ Inches Daily

MEASUREMENT of ice flow in the glaciers of Mount Hood near Portland, Ore., has been begun recently by the research committee of "Mazamas," an Oregon organization of mountaineers. The plan of observation is to run lines across a glacier with a transit, mark a number of points in the ice and then rerun the same lines from time to time measuring the movement of the marked points.

The work has been done chiefly on Eliot glacier on the north side of the mountain which, the committee states, in reporting on its 1925 work in the club's annual magazine, "was selected for observation because it is a typical glacier, has most of the characteristics common to mountain glaciers and is the longest ice stream on the mountain." Lines were run this year at El. 7800 and El. 7200 and were rerun every three weeks for a period of nine weeks. At the higher level where the glacier is 2,400 ft. wide, 11 stakes were set, some in packed snow and others, where ice was exposed, were put in holes drilled in the ice by hand with an ordinary rock drill bit welded to the end of a length of iron pipe.

"A most noticeable feature," the committee states, "was the rapid melting of the ice in the central part of the glacier. About one foot per week of solid ice melted during the first six weeks of observation. During the second period of three weeks several stakes that had been sunk 4 ft. into the solid ice had melted out and fallen down. This melting of the ice constitutes our greatest problem in measuring the flow. It is very hard work to drill the holes, the vigorous effort of two men for about an hour being required to drill a hole 4 ft. deep.

"The committee tried several kinds of drill points but has reached no conclusion as to the best type. After the holes were started, water was poured in to float out the ice chips. It was found that the presence of water greatly facilitated the drilling.

"The committee plans to try various types of metal plates as ice markers. The problem will be to get one of suitable thickness to transmit such an amount of heat to the ice beneath that it will melt at the same rate as the surrounding surface. At the same time the marker must be of sufficient weight not to blow away."

MEASURING GLACIAL FLOW ON MOUNT HOOD
Dotted line from the transit indicates initial position of stakes. Locations indicated by circled figures show later positions of same points.

The maximum movement of ice observed was about two-thirds the way across from the southeasterly side of the glacier, where there was a uniform flow of about 7½ in. daily during the nine-week period when observations were possible. From this maximum the movement decreased to a minimum in the stake nearest the edge, which moved 1¾ in. daily in the first period, 2½ in. in the next period and 1 in. in the third period, this movement corresponding to some extent to temperatures prevalent during these periods.

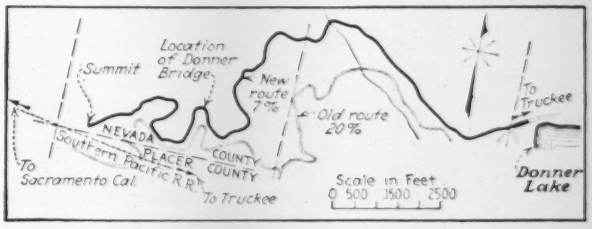
Measurements were continued into the fall until snow prevented further observation. The markers were anchored well for the winter so they can be located next spring to determine the amount of winter flow. It is proposed to initiate next season similar observations on other of the more accessible glaciers on the mountain.

Concrete Arch Bridge at Donner Summit, Calif.

Bridge Roadway Curved on 360-Ft. Radius with 7 Per Cent Grade—New Route Replaces 20 Per Cent Grades

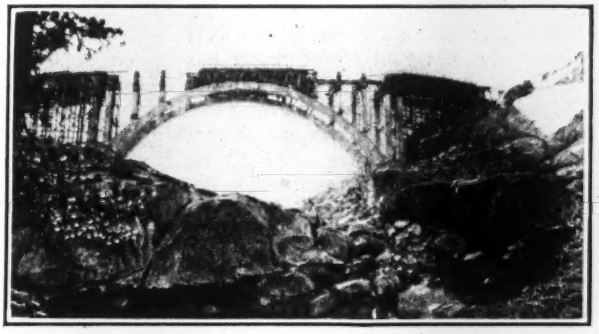
A RELOCATION of the state highway over the Sierra Nevada Mountains in California which is now under construction will provide a route to Donner Lake with maximum grades of 7 per cent, replacing a route on which the grades ranged up to 20 per cent. A spectacular feature of the new route is the concrete arch bridge close to the summit which carries a curved, superelevated roadway on a 7 per cent grade. This bridge is located at El. 7,000 in a picturesque and historic spot six miles west of Donner Lake where the ill-fated Donner party was lost in 1851.

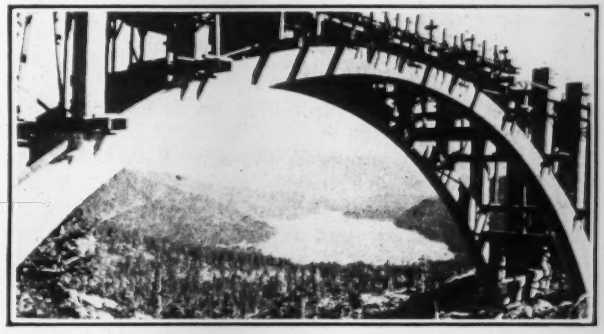
The work now nearing completion on this new route is being done as a joint state and forest highway project; design of the bridge and grading on the road from the summit to Donner Lake were under state direction while construction of the bridge and surfacing of the road are under the supervision of the U. S. Bureau of Public Roads as a forest highway project. Construction on the bridge was closed down for the winter about Nov. 1 but is to be resumed when the snow goes off in the spring so that the road can be open for travel next summer.



KEY MAP SHOWING LOCATION OF BRIDGE

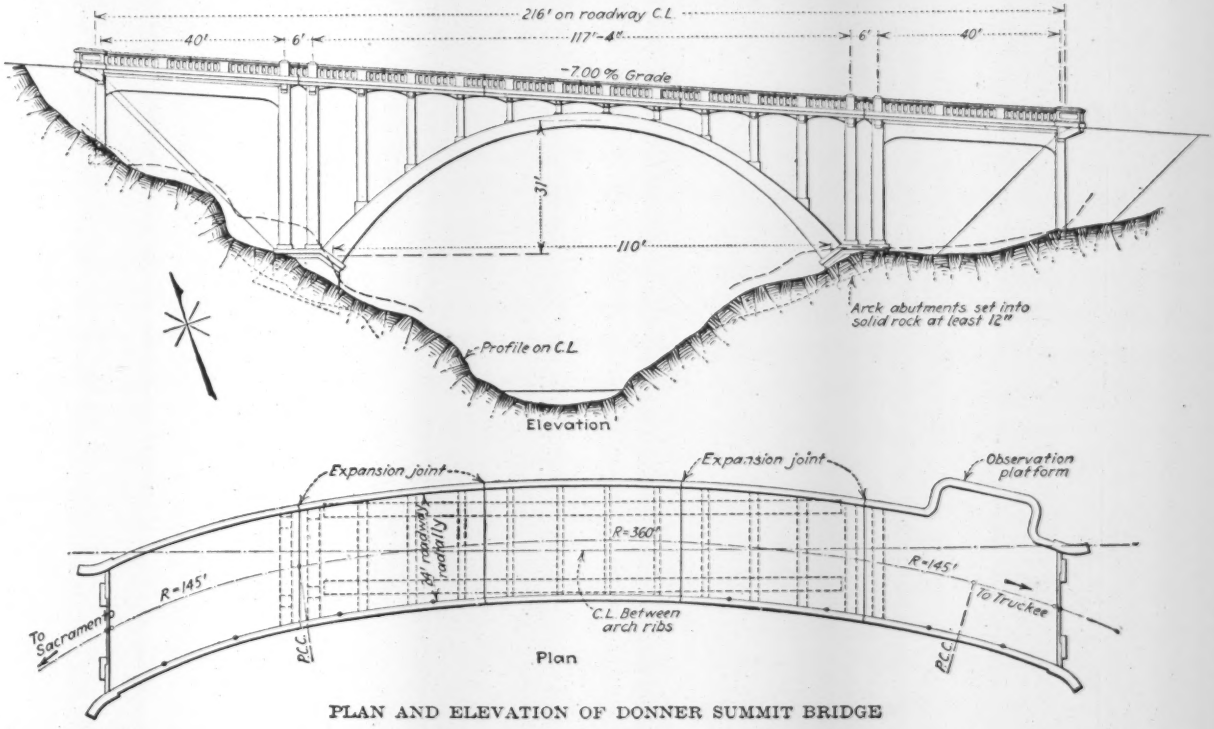
The bridge has a central arch span of 110 ft., two 40-ft. approach spans and a fourth span added as an afterthought at the east end to avoid the necessity for an approach fill at this point and also to afford a support for an observation platform.





DONNER SUMMIT BRIDGE FROM BELOW (LEFT); LOOKING EAST TO DONNER LAKE (RIGHT)

Over the main span the roadway center line is curved



PLAN AND ELEVATION OF DONNER SUMMIT BRIDGE

on a radius of 360 ft. with 145-ft. radius curves on the approaches. The roadway has an 18-in. superelevation on the outside of the curve; the width is 24 ft., and the grade, 7 per cent. The observation platform is 7x22 ft. in size, raised 17 in. above the roadway surface and commands an unobstructed view of the valley and the lake below. A large parking space is provided at the east end of the bridge, commanding the same lake view as does the observation platform.

Designs were prepared by the bridge department of the California State Highway Commission. On construction, under the general direction of the U. S. Bureau of Public Roads, C. S. Bruning was resident engineer. Contract is held by C. C. Gildersleeve.

Analysis of Plan to Form Sixth Great Lake in Canada

Diversion of Waters of Two Canadian Rivers Into Lake Superior Too Expensive—Formation of Sixth Great Lake Impossible

LAKE level restoration by the diversion of Canadian rivers from the Hudson Bay watershed is receiving attention in Canada and the United States. Several schemes have been proposed, the most recent, and the one which has received considerable publicity, is one to create a sixth Great Lake in Northern Ontario by damming the Albany and Ogoki Rivers, and turning the water from this lake south through a canal into Lake Nipigon and Lake Superior. Published maps of the region north of Lake Superior give meager data concerning the conformation of the land but records of the elevation of many of the lakes make it possible to analyze the situation sufficiently to determine that the sixth lake is a myth and the cost of diversion much beyond the cost of other known remedial measures.

Seven years of light rainfall in the Great Lakes region coupled with the various artificial conditions have so lowered the lakes that every plan suggested for their restoration deserves the serious consideration of engineers. The problem is so complicated that it almost automatically places itself outside the realm of layman understanding and thereby imposes on the engineering profession the greater responsibility to analyze every possible solution. Levels in Lakes Superior, Michigan, Huron and Erie are lower than have heretofore been recorded. Making allowances for the rise due to the Gut dam across the portion of its outlet channel, Lake Ontario is within 3 in. of its lowest annual stage. Superior is low and its condition can be ascribed only to lack of rainfall since it has been artificially regulated since 1916 and all the water possible to retain has been held back to keep up its level. Michigan and Huron are down 3 ft. below normal due, so far as the best engineering analysis can show, to the following causes: Retention in Superior, 3 in.; diversion at Chicago, 5 in.; improved channels between Huron and Erie, 8 in.; backwater effect from lowering Erie due to diversion at Niagara and Welland Canal, 2 in. and deficient rainfall, 18 in.

C. Lorne Campbell, of Toronto, a railway builder, in a pamphlet issued in September, 1925, has the most ambitious of the various schemes proposed for lake level restoration. Since the pamphlet has been given wide circulation and is made the basis of "boiler plate" stories fed to syndicated papers, engineers should know what there is in it.

Mr. Campbell proposes to dam the Albany River and its tributary, the Ogoki River, turning their waters—which now flow northeast into James Bay and thence into the ocean by way of Hudson Bay—southward through a canal cut through the continental divide into Lake Nipigon, whence they would flow into Lake Superior and the other Great Lakes. These dams, according to the pamphlets, would create a new lake with an area of about 15,000 square miles in the watersheds of the Ogoki and Albany Rivers and provide an additional flow of water into Lake Superior of approximately 15,000 sec.-ft. Navigation through the canal to be built between the new lake and Lake Superior is also contemplated.

The known facts in the matter may be briefly summarized. The elevation of Lake Superior is 602 ft. above mean sea level. The elevation of Lake Nipigon is 852. Power is developed in the Nipigon River at Cameron Falls, between Lake Nipigon and Lake Superior. The crest of the divide between the Nipigon basin and the Ogoki River basin has an elevation of something over 1,100 ft. to the northeast of Lake Nipigon and an elevation of over 1,200 ft. to the northwest of Lake Nipigon, while due west of this lake it has an elevation of about 1,500 ft. So far as the maps show the lowest gap in this divide is at Summit Lake, to the northeast of Lake Nipigon, which has an elevation of 1,100 ft. although there may be a lower gap on the line of the Little Jackfish River canoe route from Lake Nipigon to the Ogoki.

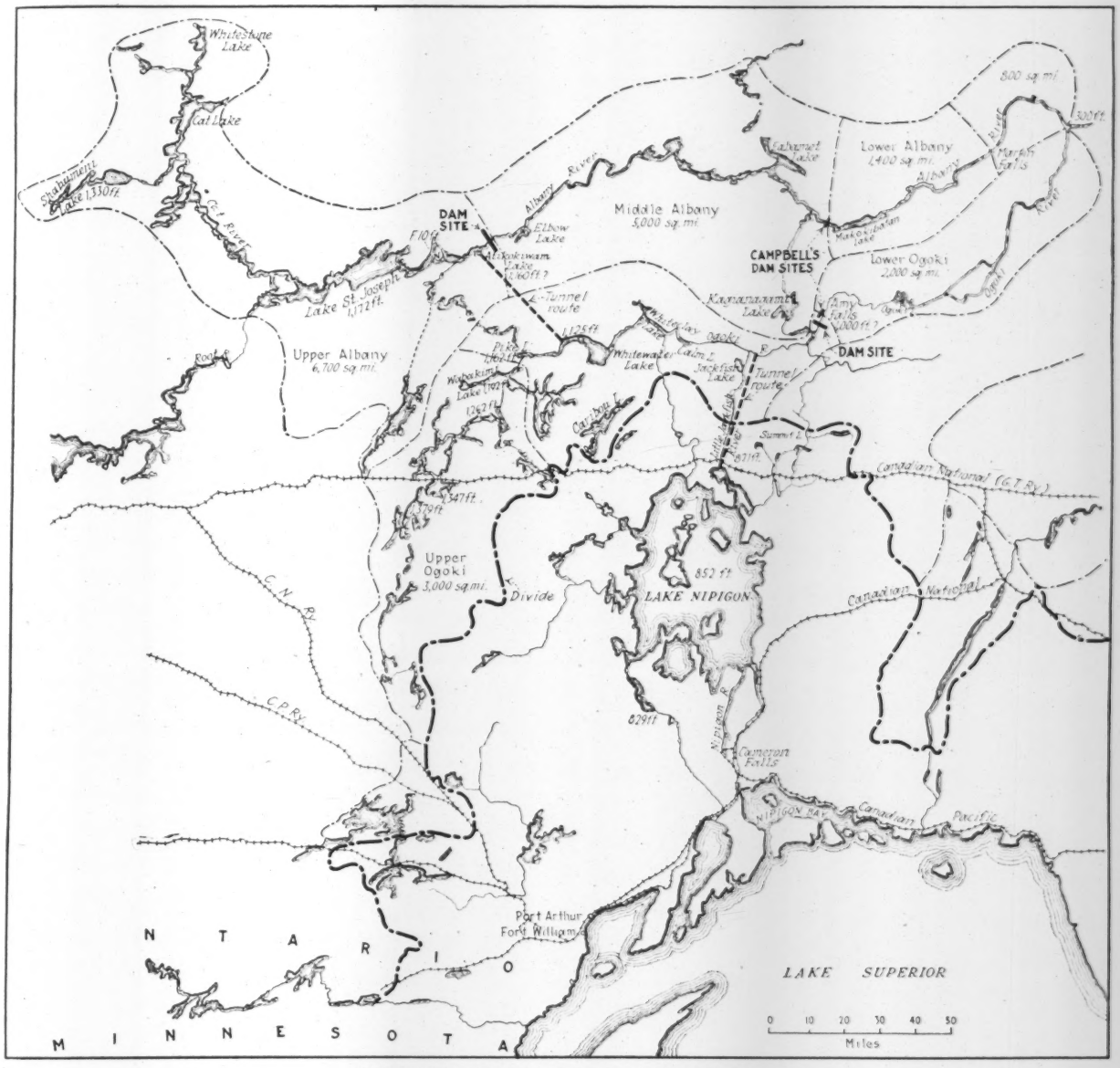
The headwaters of the Ogoki River to the southwest of Lake Nipigon are higher than 1,500 ft. and drain north to Lake Wabakimi which lies to the northwest of Lake Nipigon and which has an elevation of 1,192 ft. From this lake the Ogoki River flows northeast, down three rapids to Pike Lake (estimated El. 1,162 ft.) and thence east and down six rapids into Whitewater Lake (estimated El. 1,125 ft.). From Whitewater Lake the Ogoki flows generally east through Whiteclay Lake and Calm Lake, then down some rapids and on about 50 miles to Amy Falls, where it drops about 25 ft. The water level above Amy Falls is about 1,000 ft. The watershed of the Ogoki River above Amy Falls is approximately 6,000 square miles. The estimated average discharge of water from this area, judging from Canadian rainfall and runoff statistics, is 6,000 sec.-ft. or 1 sec.-ft. per square mile. This runoff is taken from "Water Powers of Canada," published in 1911, which gives 8,000 square miles as this drainage area. The estimated minimum flow of the Ogoki River at Amy Falls is 3,200 sec.-ft.

None of the maps of this region gives any elevations on the divide between Ogoki and Albany Rivers. This divide may not be more than 50 or 60 ft. higher than the Ogoki River level.

The Albany River is lower than the Ogoki. Its headwaters start at an elevation less than 1,400 ft. in Lake Shabumeni (El. 1,330) and in Whitestone Lake which drains south through Cat Lake and on southeast by way of Cat River to Lake St. Joseph. The waters of Lake St. Joseph are at elevation 1,172. Lake St. Joseph drains to the east into Lake Atikokiwam (estimated El. 1,160 ft.) and from thence the Albany River flows eastward with many rapids and falls, dropping probably 260 ft. in about 120 miles. The maps show no

elevation for the Albany River, but Eabamet Lake, at El. 900, drains down into the Albany through one rapid, hence the Albany at the outlet of Eabamet Lake must be at an elevation approximately 890 ft. From this point the Albany River runs southeast over three rapids to Makokibatan Lake (estimated El. 875 ft.) with a runoff of about 6,000 sec.-ft. No elevations are available on the divide north of the Albany River but it is doubtful if it is more than 75 ft. higher than the Albany River.

Sixth Lake Plan Not Feasible—From the above it is seen that the Campbell plan for a Sixth Great Lake is



RIVER BASINS NORTH OF LAKE SUPERIOR
Lake Nipigon drainage is south into Lake Superior. The Albany and Ogoki Rivers flow north to Hudson Bay.

which lies 24 miles north of Amy Falls of the Ogoki River where the Ogoki has an elevation of about 1,000 ft. and is about 125 ft. higher than the Albany River. About 50 miles east of the head of Makokibatan Lake, the Albany River drops 25 ft. at Martin Falls. The watershed of the Albany River above Martin Falls is approximately 13,200 square miles with an average runoff of 13,000 sec.-ft. Above the head of Makokibatan Lake the Albany has a drainage area of about 12,000 square miles, with an estimated average runoff of 12,000 sec.-ft. The Albany River watershed above Lake Atikokiwam is approximately 6,000 square miles in extent, not feasible. It would be impossible to create a lake 15,000 square miles in area. The combined watersheds of the Ogoki River above Amy Falls (6,000 square miles) and the Albany River above Makokibatan Lake (12,000 square miles) amount to only 18,000 square miles. Assuming the creation of such a lake, its surface elevation would probably be somewhere between 1,050 and 1,100 ft. At the highest figure the Ogoki River might be backed up beyond Whiteclay Lake but not as far as Whitewater Lake and the Albany would be backed up to Elbow Lake. The area flooded would then be about 1,500 square miles on the Ogoki and

4,500 square miles on the Albany, a total of about 6,000 square miles. This would mean a dam across the Albany Valley near Makokibatan Lake about 200 ft. high and of great length; also the raising of the general level of the divide north of the Albany River for many miles west of this dam.

Diversion to Great Lakes—A diversion of water from the Albany and Ogoki Rivers into Lake Nipigon is feasible, but very expensive.

A dam could be built across the Albany River near the east end of Lake Atikokiwam, raising the water surface to the level of Lake St. Joseph (El. 1,172) and collecting the drainage from more than 6,000 square miles of area or about 6,000 sec.-ft. Qualified American engineers have made as careful estimates of costs as the data warrant. Such a dam might cost $10,000,000. A conduit capable of carrying 6,000 sec.-ft. could be constructed from Lake Atikokiwam on the Albany, a distance of 33 miles to Whitewater Lake (El. 1,125±) on the Ogoki River at a cost of about $60,000,000. A canal from the Albany River to the Ogoki terminating either at Whitewater Lake or Whiteclay Lake might be cheaper than a tunnel. A survey of the divide between the two rivers would determine whether or not the topography is such as to make a canal feasible. It is safe to say that 6,000 sec.-ft. or more can be diverted from the Albany River into the Ogoki River at a cost of $70,000,000 or $11,667 per sec.-ft.

A dam could be built across the Ogoki Valley above Amy Falls, probably the best site for a dam on the whole river for this purpose. The river at this point has an elevation of about 1,000. A dam 60 ft. high would cost about $20,000,000. This would make a lake of the Ogoki Valley extending upstream perhaps as far as the foot of Whiteclay Lake. A conduit capable of carrying 12,000 sec.-ft. could be constructed from the Ogoki River to Lake Nipigon approximately on the line of the Jackfish and Little Jackfish Rivers, of a total length of only 34 miles, at a cost of about $65,000,000. A canal over all of this distance if possible, or even for part of the distance, might prove less expensive to construct. A diversion of 12,000 sec.-ft. of water from the Ogoki River to Lake Nipigon would thus cost approximately $85,000,000. To get some 6,000 sec.-ft. of this from the Albany River into the Ogoki would cost $70,000,000 more, making the total cost of diversion of 12,000 sec.-ft. of water from the Hudson Bay watershed into the Great Lakes amount to $155,000,000 or $12,900 per second-foot.

The unit prices per cubic yard used in making the estimates above were as follows: Excavation in tunnel $4; fill in dams, $3; concrete in tunnel lining, $30; concrete in dams, $20.

The addition of 12,000 sec.-ft. of water to the Great Lakes would raise these lake levels about 7 in. From a power standpoint, it could be used to produce an additional 250,000 hp. on the Nipigon River and an additional 600,000 hp. at Niagara Falls and on the St. Lawrence River.

An increase of 7 in. in lake levels, while desirable, solves but a small portion of this much discussed problem. Regulating works at the outlets of Lakes Huron and Erie, proposed by the U. S. Army engineers and many others, could bring the lakes back to normal level and hold them under control at any desired level. Such works have been estimated at $10,000,000 in the Niagara River and not more than $10,000,000 in the St. Clair River, a total expense of $20,000,000. In addition to restoring lake levels by holding back flood waters which are now permitted to run to waste, such works are estimated to increase the low water outflow from the lakes in the driest month various amounts but by at least 6,000 sec.-ft.

Since the increase in outflow from the lakes is of value only for power purposes and since an additional 6,000 sec.-ft. could be obtained in the critical time of extreme low outflow at a cost of $20,000,000 or $3,330 per sec.-ft. it is safe to conclude that in the present state of water-power development at Niagara, water is not worth this much. If it were, then the power interests would advocate regulating works.

High Overflow Dam Main Unit of Baker Power Plant

Part of Diversion Tunnel Also Serves Power Uses—Final Tunnel Blast Admits Water—Features of Dam and Plant

THE Baker River hydro-electric project completed early in November is located about 115 miles northeast of Seattle in the canyon of the Baker River, a tributary of the Skagit. The plant was built by Stone & Webster, Inc., and the energy developed is added to the system in western Washington operated by the Puget Sound Power and Light Co. The dam, which is only 1,050 ft. from the power house, diverts the water directly into a tunnel whence it enters a short penstock line, thus making a compact development with a corresponding simplification of construction and operating requirements. In laying out the project, construction was planned so that after the diversion tunnel was no longer needed as a bypass the river ends could be plugged off and the greater part of its length could be used as part of the main supply tunnel.

The most critical and costly part of the Baker River project was the foundation work on the dam. The stream is subject to sudden rises and at this stage of the work there were several floods that delayed the work and made considerable reconstruction necessary. However, after a long close race with the high water in the fall of 1924 the work was finally brought up to a point where four days more of concreting would have raised the dam above flood danger point and assured the effective diversion of floods through the bypass tunnel so that work could have gone on through the winter.

Just at this critical time, the I.W.W.'s, 300 strong, took possession and shut down the job for a three-week period. That delay lost months of time and made it necessary to fight the river for six months to gain the advantage lost. In the end, but too late to save the extra cost, delay and "grief" to the construction staff, the I.W.W.'s were taken off the job and out of the country by the sheriff, so that their defeat was complete.

The Baker River is only 20 miles long and has a drainage area of 270 square miles, including some glacial and snow-field areas above El. 5,000. For the most part the basin consists of rough, broken country and in many places the river has cut deep gorges through solid rock. It is in one of these canyons, near the confluence with the Skagit, that the Baker River development is located.

Although precipitation records in the Baker watershed are very meager, it is believed that on some parts

of the basin the rainfall is as high as 200 in. per year. In the period between 1911 and 1924 the maximum stream flow was 27,400 sec.-ft. and the minimum flow 398 sec.-ft. For this period the total annual runoff averaged about 1,500,000 acre-ft. The reservoir will store, 70,000 acre-ft. and under full load the flow required to supply the turbines when the later additions

FIG. 1—BAKER RIVER DAM FROM STREAM BED BELOW

to the power plant are in service will be 4,000 sec.-ft. Under the rainfall and runoff conditions that may be expected in this basin it is believed that the storage is sufficient to supply the plant during the low water periods at 50 per cent load factor.

The dam is curved on a radius of 250 ft., has a total height of 263 ft. from bedrock to top of gate piers, and a crest length of 493 ft. At the greatest depth the total width of the cross-section, including the apron, is 180 ft. The dam is of the overpour type, with spillway control by means of gates on the crest. The crest is divided into sections 10 ft. wide in the clear by piers between which 10 x 12-ft. gates are operated by a device traveling along the pier tops.

The gorge in which the dam is located is more than 300 ft. deep with nearly vertical sides. The stream bed is in solid limestone, pitted with pot holes and roughened with ridges which afford excellent bond for the masonry of the dam. Bedrock was found at an average of 35 ft. below the bed of the river.

Before excavation for dam foundations was begun, a diversion tunnel, 17 x 24 ft. in section, was driven from a point 300 ft. below the downstream toe to the point of temporary diversion, some 200 ft. above the upstream face of the dam. This tunnel was located well below the surface of the stream so that the greater portion of the flow would pass through it without requiring a high temporary diversion structure. In order to drive the tunnel at this low level the work was advanced toward the upstream end working in from the downstream portal and from adits. This was done at a low stage of the river. When the upper end of the tunnel was nearing the river, an opening through the remaining wall was made at the very top of the tunnel, just above water level. Then a final blast was placed which entirely removed the remaining dike at the tunnel intake and the water entered. Fig. 4 shows dimensions at the tunnel intake when the blast was fired on Aug. 20, 1924.

Immediately after the blast the diversion dams above and below the main dam site were constructed. These were cofferdams made of 10 x 10-in. timbers in such form that a central space between two rock-filled cribs could be filled with puddled clay. Three temporary openings, 12 x 20 ft. in size, were left in the dam for the river flow after the diversion tunnel was closed.

When the concrete work in the main dam had been brought to a level such that the diversion tunnel was no longer needed, closure was made by putting down stop logs in grooves which had been placed in an access shaft for this purpose. These stop logs were 12 x 28-in. timbers and the first six were fastened together to avoid the danger of wedging the grooves as they went down through the 17-ft. depth of water. After the first six the stop logs were added one at a time. When closure was effected in this manner the current through the tunnel was 15 ft. per sec. and the stop logs went into place with a violent slam.

After closure with the stop logs a concrete plug was placed in this end of the tunnel to seal it permanently. A similar plug was also placed near the outlet end of the diversion tunnel and the tunnel was extended to reach the upper end of the steel penstock line.

The permanent inlet to the power tunnel is located in

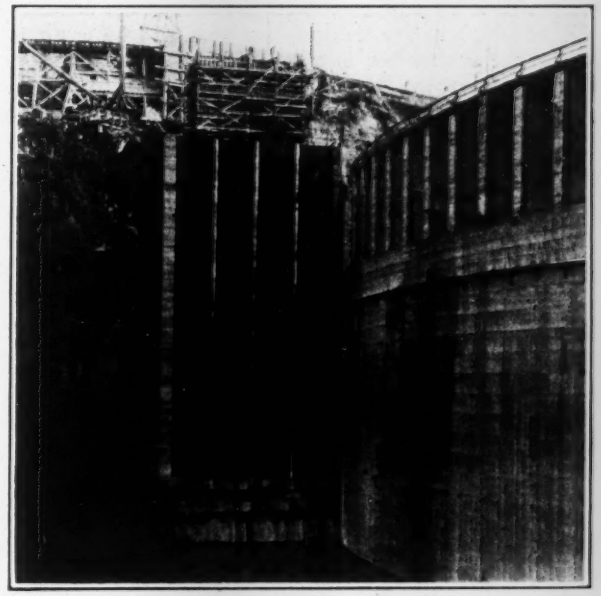


FIG. 2—INTAKE IN TOWER INTEGRAL WITH DAM

a concrete intake tower built integral with the dam on the east side of the canyon, Fig. 2. The gate sill is at El. 330. The gates, protected by rack bars, close the two openings which are roughly two halves of a circle separated by a concrete wall and which merge into a single circular tunnel about 20 ft. back of the gates. Here the tunnel turns directly downward to an intake shaft, 22 ft. in diameter, inside, leading down to the pressure tunnel. The gates themselves are 12 ft. wide by 20 ft. high, made of plate steel with brass liners. They are raised and lowered by means of hydraulic

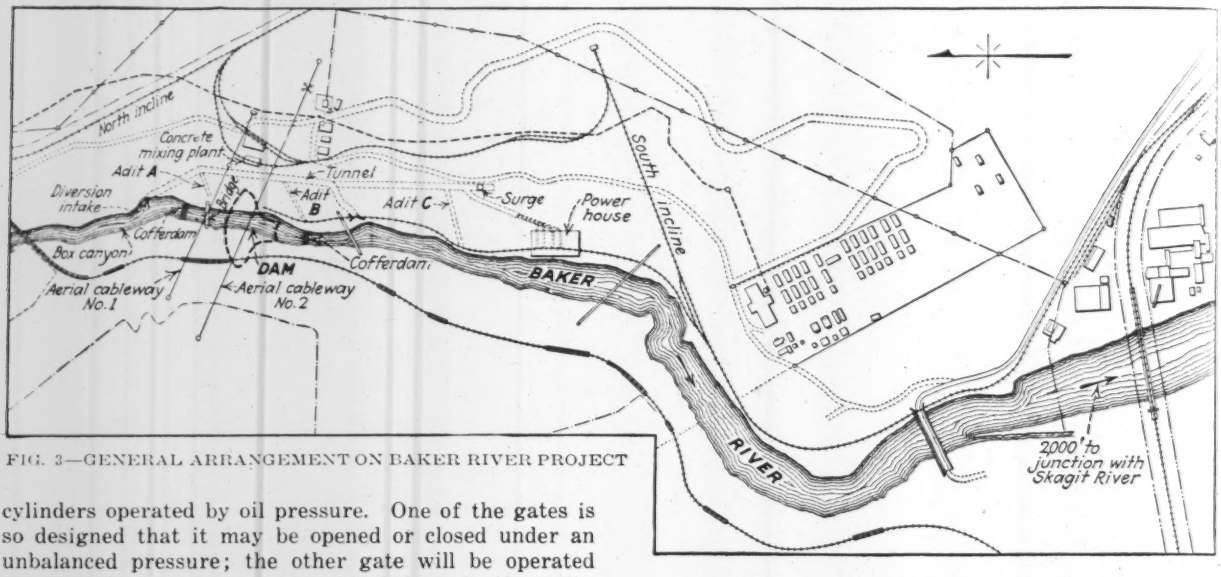


FIG. 3—GENERAL ARRANGEMENT ON BAKER RIVER PROJECT

cylinders operated by oil pressure. One of the gates is so designed that it may be opened or closed under an unbalanced pressure; the other gate will be operated only when the water pressure is balanced. In order that the tunnel may be filled without opening the large gate, two 24-in. bypass gates are located at El. 360.

The pressure tunnel driven 24 ft. in diam. (22 ft. inside concrete lining) extends 890 ft. from the intake shaft to the surge chamber at the lower end of the tunnel. The tunnel size is sufficient to deliver 4,000 sec.-ft. at a velocity of 10½ ft. per sec. This quantity will be sufficient for the ultimate four hydraulic units.

The surge chamber is a cylinder 20 ft. in diameter extending upward from the pressure tunnel to a total height of 250 ft., which is about 5 ft. above the ground

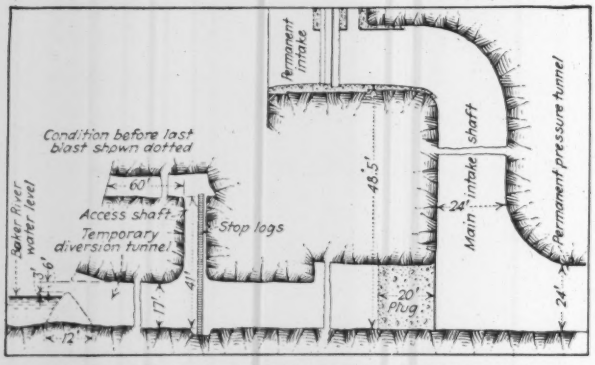


FIG. 4—TEMPORARY AND PERMANENT INTAKES

surface. A spillway opening at El. 420 leads to a small draw upstream from the power house.

The units now in service are supplied through a branch tunnel, 18 ft. in diameter, which branches off from the main line 65 ft. upstream from the surge chamber. The two additional units to be installed later will be supplied by the extension of the tunnel which now ends near the base of the surge chamber. The surge chamber is only 500 ft. from the waterwheels, which is expected to give excellent hydraulic regulation.

Two penstocks serve each of the two units, each penstock being 8 ft. in diameter throughout its length and reducing to 7 ft. inside the power house where it delivers through an 84-in. butterfly valve. The penstocks open directly into the tunnel, without upstream gate.

The hydraulic units are of the double-overhung Francis type, each rated at 24,500 hp. under an effective head of 230 ft. The power house is 98 ft. wide, 154 ft. long, with space available at the south end for a 112-ft.

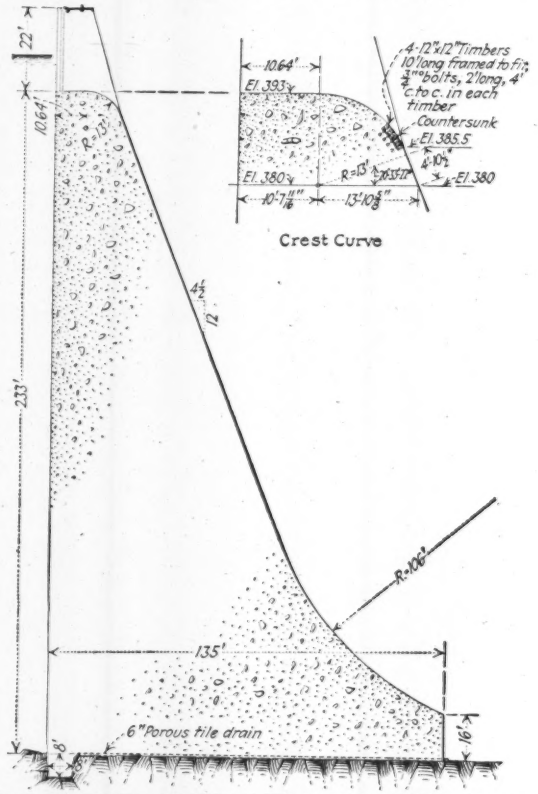


FIG. 5—MAXIMUM CROSS-SECTION OF BAKER RIVER DAM

extension which is to be made when the two additional units are installed. Power is delivered over a 110,000-volt transmission line which ties in to the company's substations at Sedro Wooley, and Beverly Park.

Construction on the Baker River job has been under the general direction of S. L. Shuffleton, and under the immediate supervision of W. D. Shannon, of Stone & Webster, Inc.

Progress of the Sewage Disposal Program at Chicago—I

Physical Status of this Problem of Nation-Wide Interest Described After Year Filled with Stabilizing Events—5-Year Permit Obligations Call for Largest Activated-Sludge Plant Well Under Way

By Edward J. Kelly
Chief Engineer, Sanitary District of Chicago

WIDESPREAD interest in the Chicago sewage disposal program has been focused on the problem during 1925 by reason of the termination of seven years of litigation with the federal government over water diversion, the subsequent grant of a 5-year permit for withdrawal of water from Lake Michigan by the War Department and the review of the engineering program of the Sanitary District of Chicago by one of the largest boards of consultants ever brought together. This article proposes to indicate the present status of progress toward carrying out the program suggested by the Board of Review, accepted by the Sanitary District and modified slightly by the War Department. A second article will describe both design and construction of the North Side treatment works, which will be the largest activated-sludge plant yet constructed.

Sewage disposal at Chicago by the dilution method was authorized in 1889 under an act passed by the legislature of the state of Illinois providing for the formation of sanitary districts for that purpose. The dilution method was then, as now, the only means of sewage disposal regarded as practical in a large number of instances involving great quantities of sewage. In fact 88 per cent of the sewage disposal of cities having a population of 100,000 or more is still taken care of by dilution. An independent municipal corporation designated as The Sanitary District of Chicago was created by a vote of the people following this action of the state legislature.

Since 1889, under various amendments to the original act and under permits granted by the federal government, the dilution system has been extended by the construction of two canals tributary to the original Main Drainage Canal. Also the Chicago River has been widened and deepened to avoid currents dangerous to navigation which was the only known objection to the Sanitary District dilution scheme. The entire canal system is limited in capacity to a withdrawal of approximately 10,000 sec.-ft. of diluting water from Lake Michigan, as measured at the lower end of the Main Drainage Canal in Lockport. This 10,000 sec.-ft. withdrawal from the Great Lakes System was designed under the state law, for a maximum population of 3,000,000.

Lake Water Diversion at Chicago—Aside from their function in the dilution scheme, the Sanitary District canals at Chicago are destined to have an important bearing on transportation costs over the entire country since these waterways will eventually form the northernmost link of the Deep Waterway which is to connect the Great Lakes and the Gulf of Mexico. In this sense the Sanitary District has created not merely a local utility at Chicago but a national asset.

The canal system, in order to serve the purposes of the Deep Waterway adequately, should now of necessity flow about 10,000 sec.-ft. regardless of any increased capacity of artificial sewage treatment plants at Chicago. A lesser flow would involve periodical reversals in the current of the Main Channel and the Chicago River during storms, with a consequent discharge into Lake Michigan of the present badly contamined waters of the Chicago and Des Plaines Rivers. Flood control gates at the river mouth to prevent such a discharge have been required by order of the Secretary of War in a temporary permit issued March 3, 1925.

This permit was issued to the Sanitary District by Secretary of War Weeks following seven years of federal court litigation in which the District sought to establish its right to a 10,000-sec.-ft. withdrawal from the Lake. Litigation was concluded when the Supreme Court found that a decision as to the matter of diversion at Chicago lies within the jurisdiction of the Secretary of War. Secretary Weeks subsequently issued the permit to withraw an annual average of 8,500 sec.-ft. and an instantaneous maximum of 11,000 sec.-ft. The permit is for a 5-year period and is conditioned upon the construction of artificial sewage treatment works to provide the equivalent of 100 per cent (complete) treatment of the waste from 1,200,000 persons within that time. Pursuant to the War Department order, work was started immediately and has been continued rapidly on the construction of sewage works.

Growth of Population—While the city of Chicago is increasing in population 55,000 a year, the Sanitary District of Chicago, which includes the city and 49 cities and villages in the immediate neighborhood, comprising in all an area of 437.39 sq. miles, increases in population 70,000 annually. With a present population of about 3,355,000, the District has therefore rapidly outgrown the capacity of its facilities for sewage disposal by dilution without taking into account the industrial wastes population equivalent which now amounts to about 1,600,000. By the end of 1945, the aggregate of human population plus the equivalent industrial population, it is estimated, will be 6,785,000. On this basis, the entire capacity of the dilution system will then be exceeded by 126 per cent.

Studies and Experimental Plants—Fortunately, the rapid rate of growth of the city and the Sanitary District in population, in industry, in manufacture and distribution of commodities, and in freight interchange activity by rail and water has been, in a measure, anticipated, and a broad plan has been devised whereby it is hoped to maintain sanitary conditions and sewage disposal facilities abreast of the rapid strides which the city of Chicago is making in other directions. This plan has required the Sanitary District to finance and to start construction on the largest artificial sewage treatment program ever contemplated by any city in the world.

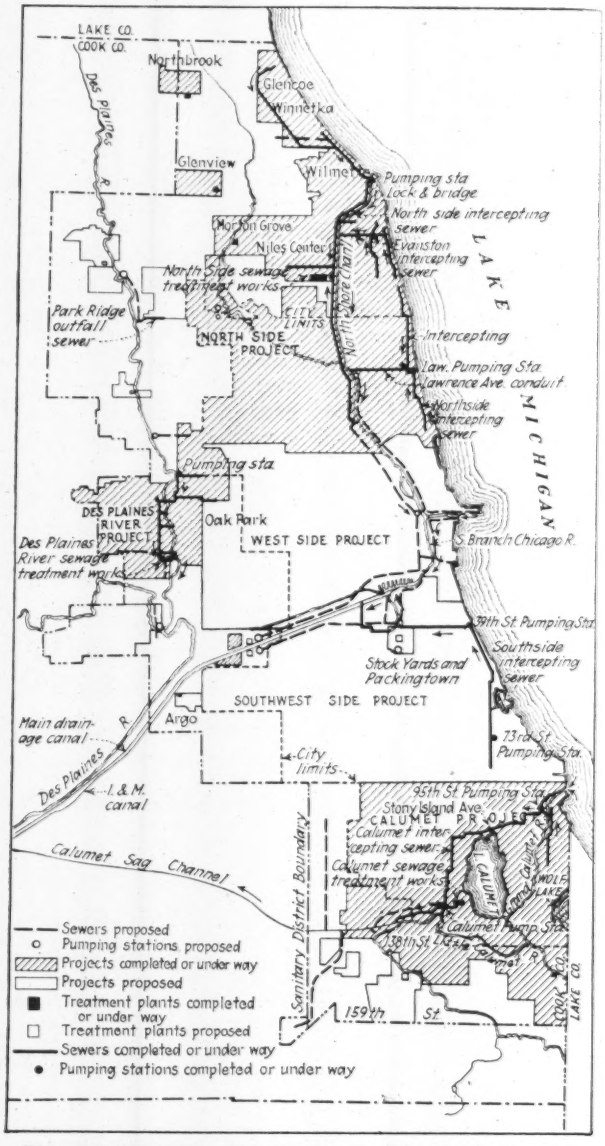
Unlike many large metropolitan centers, the city of Chicago is forced to devote the major portion of its

expenditures for water purification purposes to sewage treatment rather than directly to water purification. Indirectly, the dilution system has been a water purification system in that the sewage has been diverted from the lake, the source of the city's water supply. The most immediately apparent benefit of the dilution system has been the remarkable reduction in Chicago's typhoid fever death rate. Another great benefit of this diversion has been the making possible of the creation along the lake front of Chicago of a number of bathing beaches and recreation centers and a system of accessible driveways to these which are destined to make the city probably one of the world's most active trade convention and summer resort centers. The new scenic drives created as a part of the general lake-front improvement have also materially reduced downtown street congestion.

In anticipating the present rapidly growing necessity for artificial sewage disposal, the technical staff of the Sanitary District inaugurated studies and experimental sewage testing stations starting about the year 1908. Experiments on domestic sewage were conducted at the Thirty-ninth Street Pumping Station in the years 1908 to 1911. Studies on special trade wastes were conducted from 1912 to 1918 in an experimental station at the Stock Yards. Experiments on the wastes from the tanning industry were carried on from 1919 to 1922. Investigations to determine the most practical method of treating industrial wastes from the corn products industry at Argo were started in 1920. It is estimated that in order to provide a comprehensive sewage disposal system for the entire district and one which will be capable of adequate expansion, it will be necessary to expend (including $30,000,000 already spent plus the cost of new bridges over the drainage canals), public moneys amounting to $125,000,000 by the year 1945. A considerable expenditure to determine the most economical and practical method of sewage treatment was therefore justified. The cost of technical studies and experiments to date has been over $500,000. As a result of technical research, a definite program was outlined by the year 1919 notwithstanding the comparatively meager state of our knowledge of sewage treatment as applied to very large quantities of sewage, at the time when the experiments and studies were started.

Experimental work has not been confined to studies conducted at small model sewage testing stations but has been extended to practical operating plants on a large scale. For example, the sewage disposal works of the Calumet District were designed and constructed with a view to the accumulation of additional data on the Imhoff-tank, trickling-filter and activated-sludge methods of treatment. These works are designed to treat the sewage coming from some 42½ sq. miles of surrounding territory with a present population of about 192,500. There are thirty units of double-deck Imhoff tanks and two units in which the activated-sludge process is used. There is one trickling filter unit to give complete treatment to sewage passing through one of the Imhoff tank units. Experiments can therefore be conducted on a working scale to compare sedimentation plus trickling-filter treatment with the activated-sludge method and to determine the direction of future expansion at this plant as well as to compile the resulting data for use in connection with the still larger projects now under construction and to be constructed in the future.

It does not appear likely that after the very largest artificial treatment works are in operation we shall be



EXISTING WORKS AND PROPOSED PROJECTS OF THE SANITARY DISTRICT OF CHICAGO

able to dispose of the enormous production of sludge as fertilizer at a profit. The cost of drying the sludge to a sufficiently low moisture content may not justify the plant investment and operating cost involved. However, future developments are anticipated along these lines, and with this in view the Des Plaines River treatment plant and the two activated-sludge units at the Calumet works have been equipped for sludge drying. The present dried sludge output at the Des Plaines works is selling at about $22.50 a ton. For the past year, experiments have been conducted at the Calumet works on the return of activated sludge from a 1.75-m.g.d. unit to an Imhoff tank for digestion with Imhoff tank sludge. This rather unique experiment appears to have been successful.

Some progress has been made in investigations at Milwaukee and Chicago as to methods of utilizing dried sludge. There is quite a demand on the part of golf clubs, flower growers, fruit growers and fertilizer manufacturers, for the organic nitrogen in the dried sludge. The best market at present appears to be with fertilizer manufacturers, who use the sludge as a filler to supply organic nitrogen in the fertilizer mixture. The Milwaukee Sewerage Commission in co-operation with the Sanitary District of Chicago has distributed prepared activated sludge for trial to many golf clubs. These clubs have now requested sufficient sludge for their entire needs, which cannot as yet be supplied. Dried sludge as a fertilizer has given satisfactory results on several types of soil and on staple crops such as corn, tobacco, potatoes, tomatoes and cereals. Chicago and Milwaukee investigations indicate that the sludge is better than sodium nitrate as grass fertilizer. An excess of sludge does not burn the grass as does an excess of nitrate of soda.

Six Major Projects—The entire Sanitary District has been divided into five main areas for sewage treatment purposes. Each of these sections will be served by a major sewage treatment project. There will be also a separate disposal plant for the industrial wastes produced at Argo by the plant of the Corn Products Refining Co. The wastes from the Stock Yards and Packing Town will be partially treated at a separate disposal plant. Wastes from the tannery district will be included in one or more of the five projects above mentioned. A further subdivision of the program will include a number of disposal plants for the 49 outlying towns and villages so located as to render it economical to work out separate solutions for these problems. Complete treatment, at an ultimate cost of $11,786,000, is contemplated.

Des Plaines River Project—The Des Plaines River sewage treatment project, in operation since 1922, is the first of the major plants to be completed. As stated, this is in part an experimental plant utilizing the activated-sludge process. The results of research conducted here have had an important influence on design considerations for the North Side activated-sludge plant as well as on the remaining large projects. It is estimated that the Des Plaines River plant will have to provide for a population of 105,000 by 1945. Additions and enlargements will be necessary in the near future in order to meet the demands of the increasing load. The construction cost of the project has been over $3,270,000. Future connections and additions are estimated to cost $570,000.

Calumet—The Calumet sewage treatment project is the second of the major sewage disposal projects to be completed. The tributary sewers, pumping station and power plant which were constructed as a part of this project serve as an adjunct to the general dilution scheme, in that they act as feeders to the Calumet Sag Channel in the dilution project. The entire Calumet plant, including pumping stations, power plant, tributary sewers, Imhoff tanks and activated-sludge units, is now completed and in operation. Much of the present plant was built at war prices and under unfavorable labor conditions. The estimated cost of the project, including tributary facilities, for the present capacity, is $17,360,000. Future extensions, including the addition of trickling filters, are estimated to cost $5,061,000.

North Side—The third of the major projects from the standpoint of anticipated time of completion is the North Side sewage treatment works now under construction. It will serve an area of about 62 sq. miles, estimated to have a population of 1,450,000 in 1960. This will be the largest activated-sludge plant ever built. The effluent will be discharged into the North Shore Channel which is one of the channels incorporated in the dilution project. The effluent will flow from the point of discharge by way of the North Branch and the South Branch of the Chicago River to the Main Drainage Canal of the Sanitary District. Since this course leads through the heart of the downtown district of the city, it is desirable that the effluent be of a character that will not be likely to cause nuisance. Complete treatment is therefore contemplated. That is, the oxygen demand of the sewage will be reduced about 90 per cent. The total estimated cost of the completed North Side plant is $27,433,000, including the cost of the collecting sewerage system. Completion of the plant is scheduled for 1928.

West Side—The fourth and by far the largest of the major projects is the West Side sewage treatment project which will serve an area of 57½ sq. miles lying in the central portion of the Sanitary District. The present tributary population is 1,365,000 and the estimated 1945 population is 1,615,000. An allowance has been made for an additional equivalent population of 300,000 to care for the transient population in the loop and the commercial districts in the West Side area. The plant will be situated just north of the Main Drainage Canal and outside of the western city limits. This will be an Imhoff-tank installation with sludge drying beds estimated, including sewers, to cost $25,261,000. Consideration is being given to the construction of sludge-digestion chambers to a capacity sufficient to receive sludge from both the West Side and the North Side projects. If this scheme is carried out, an 18-mile sludge line will be required, leading from the North Side works to the site of the West Side project. The intercepting sewers which will bring the sewage to the plant will collect the sewage now passing into the Chicago River and its North and South Branches, resulting in a very desirable improvement of the present insanitary condition of the streams and in a tendency to reduce the degree of pollution of Lake Michigan when reversals of flow of the Chicago River occur on account of rapid storm runoff. Completion of this project is set for the year 1930.

Argo and Stock Yards—The fifth major project is designated as the Industrial Wastes treatment project. It is planned that this will include the treatment of wastes from the corn products industry and from the Stock Yards and Packing Town. These industrial wastes are estimated at this time to be equivalent to the sewage coming from a human population of more than 1,600,000. Experimental data now available indicate that it will be practical to treat the trade wastes either by the activated-sludge method or by a combination of sedimentation tanks and trickling filters. The present plan contemplates fine screening at the Stock Yards, and further treatment of the affluent at the Southwest Side treatment works. The fine screening plant is estimated to cost $1,300,000 and is tentatively

scheduled for construction in the first 5-year construction period (1925-1930).

The estimated cost of the plant to treat the trade wastes from the Corn Products Refining Co. at Argo, including trickling filters, is $2,919,000, which carries the project up to the year 1945. The date set for completion of the first unit is 1927.

To expedite the settlement of controversial matters as to division of cost of construction between the Sanitary District and the packing interests, the Sanitary District recently filed two suits against various packing interests, seeking to enjoin these companies from further discharging their wastes either directly or indirectly into the canal system. The matter is now pending in the appellate court. It is believed that these suits will shortly result in a settlement of the question of cost distribution.

Southwest Side—The sixth and final major project in point of date of completion is the Southwest Side sewage treatment project which will have a tributary area of 59 sq. miles, also lying approximately in the central portion of the Sanitary District. The present population of this section is 945,000 and the estimated resident population as of 1945 is 1,322,000. The schedule for the preliminary construction stage calls for removal of the settling solids in sedimentation tanks but it is presumed that complete treatment will ultimately be required. This will necessitate the construction of trickling filters or activated-sludge units supplementary to the sedimentation tanks. Completion of the project is scheduled for 1940, at an estimated cost of $19,115,000.

The estimated cost of the entire sewage treatment program, as now planned up to 1945, is over $125,000,000 (including the cost of new bridges over the drainage canals), of which the sum of $35,000,000 has already been expended on construction work.

Annual administration, maintenance and operating costs for the six major projects and the miscellaneous treatment plants as of 1945 are estimated at $4,613,000. Such operating expense will follow a rising scale as the construction program is carried out, reaching its peak when the program has been completed. About 40 per cent of the electric power required for plant operation as of 1945 will have to be purchased since the hydro-electric plant on the Main Drainage Canal at Lockport, with a continued flow of 10,000 sec.-ft. in the canal, can supply only 60 per cent of the necessary power.

Personnel—The magnitude of the work on studies, plans and specifications has required a very complete engineering organization, as follows: Executive assistant chief engineer, Philip Harrington; assistant chief engineer in charge of sewage treatment plant design, H. P. Ramey; H. P. Beiler, architect; O. L. Eltinge, assistant engineer in charge of sewer design; J. T. Hawley, electrical engineer; I. P. Kane, assistant engineer on treatment plant design; F. W. Mohlman, chemist; S. Moreell, Jr., bridge engineer; R. R. Leffler, structural engineer; Langdon Pearse, sanitary engineer; H. S. Ripley, senior assistant engineer; H. I. Steffa, mechanical engineer; W. H. Trinkaus, in charge of field operations; and L. C. Whittemore, assistant sanitary engineer. R. B. Barker is engineer in charge of construction of the North Side treatment plant.

Welded Swimming-Pool Tank in a Chicago Club Building

Plates Welded Together and to Longitudinal Beams Bolted to Girders—Tack-Welded Stiffeners on Shell Plates

AN electrically-welded steel tank for a swimming pool 60x30 ft. on the sixth floor of the Standard Club Building, Chicago, is an interesting feature in itself, while the support of the tank involves a special arrangement of trusses and girders in the structural frame. A view of the outside of one end of the tank is shown in Fig. 4, and Fig. 1 shows a part of the interior. The tank consists of ⅜-in. bottom and side plates, the bottom plates resting on longitudinal I-beams, inclined to accommodate the varying depth of tank, and the sides and ends having stiffeners of 7-in. channels, as shown in the structural drawings, Figs. 2 and 3.

Transverse trusses and girders support the bottom I-beams which rest on wedge-shaped cast-iron blocks cored for bolts which pass through the flanges of beams and girders. Upon these I-beams are laid the bottom plates, 6 ft. wide. At the longitudinal seams the edges of the adjacent plates rest on an I-beam. They were placed with the edges ¼ in. apart, the plates being then welded continuously to this beam and the longitudinal ¼-in. channel being filled with metal by this process, thus forming a flush bottom. To the intermediate I-beams the floor plates are connected by tack welding. It will be seen that the bottom plate extends far enough beyond the sides to serve as a seat for the 7-in. stiffeners, which are welded to this plate and tack welded to the side plates. A longitudinal channel supports the edge of the bottom plate.

No special provision is made for expansion and contraction since the tank is small and in a building where there will be only a slight range of temperature variation. In testing the tank, an enclosure was built around it, and salamanders and steam coils were installed. A layer of concrete reinforced with wire-mesh is laid upon the steel plating and is covered with the glazed tile

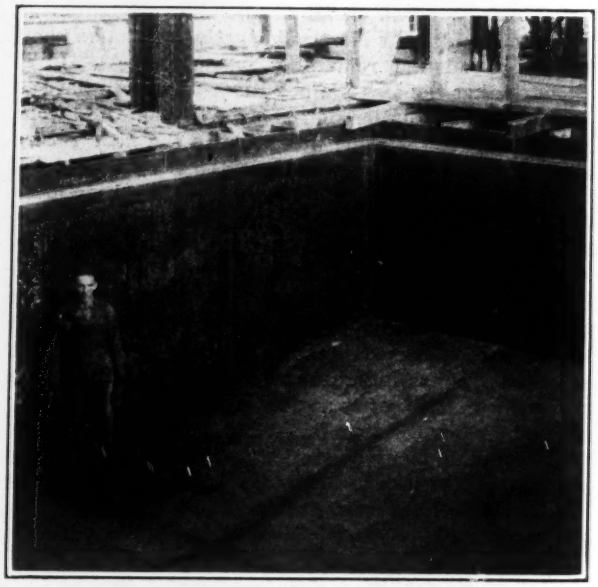


FIG. 1—INTERIOR OF WELDED TANK

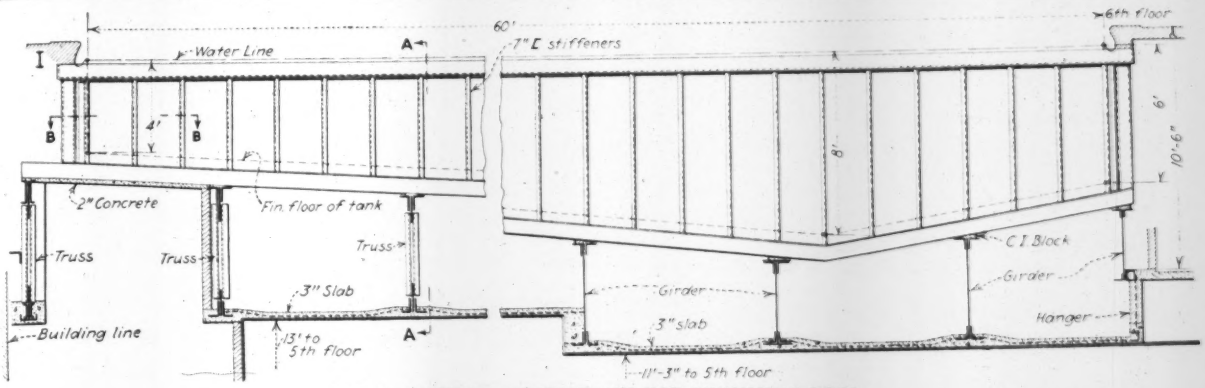


FIG. 2—WELDED STEEL TANK FOR SWIMMING POOL

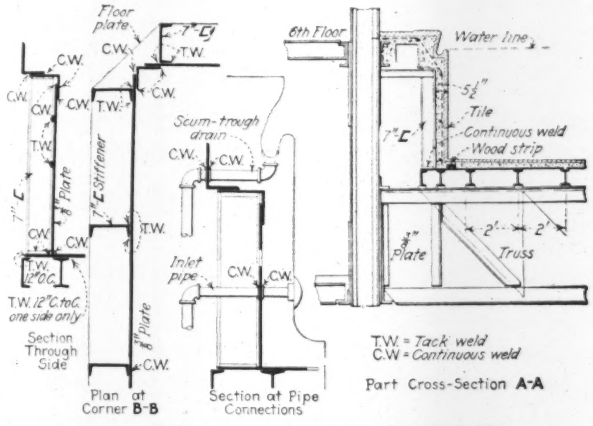


FIG. 3—DETAILS OF TANK, SHOWING WELDS

lining. This lining is shaped to form the scum trough, as shown. The ceiling under the tank is a concrete slab in which the bottom flanges of the trusses and girders are embedded, giving a headroom of 11 ft. 3 in. and 13 ft. above the finished surface of the fifth floor.

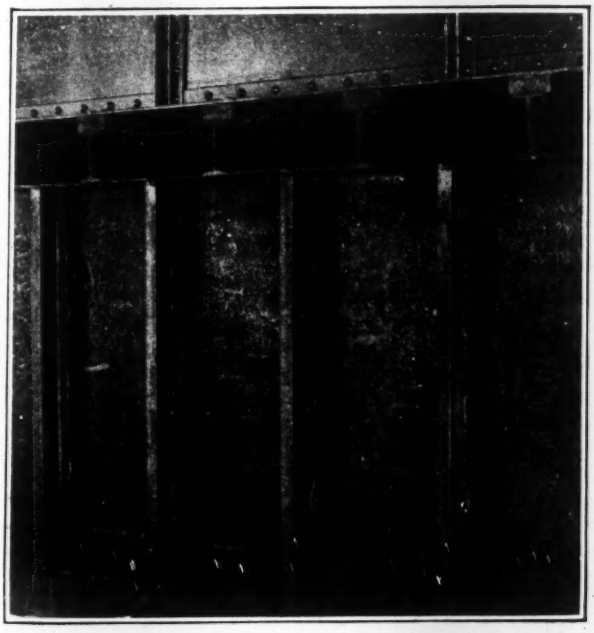


FIG. 4—OUTSIDE OF END OF TANK

Inclined I-beams seated on blocks on transverse girder. Bottom plates welded to beams. Stiffeners welded to bottom plate and tack-welded to end plate.

The location of the welds is indicated on the drawings. Where pipes enter the tank they have flanges welded to both sides of the plating, while a large drain box in the bottom is fitted to a flange welded to the plate around the opening. Both shop and field connections were welded throughout, no rivets being used in any part of the tank. The work included 1,350 ft. of continuous welding, 960 ft. of 1-in. tack welding and 350 ft. of 2-in. tack welding, all tack welds being spaced 12 in. c. to c. The total weight of plates, stiffener channels and top and corner angles was about 25 tons. Considerable economy resulted from shipping the plates directly from the mill to the building, instead of first to the contractor's shop to be laid out and punched.

The swimming-pool tank was designed by Albert Kahn, Inc., Detroit, Mich., architects and engineers for the building. It was built and installed by the Graver Corporation, East Chicago, Ind.

New York Transit-Transportation Report

A REPORT on transit and transportation, a sequel to the one on highway traffic published last year by the Committee of the Regional Plan of New York and its Environs, has just been issued. This report, the result of extensive investigation, is designed to give the public a picture of the transit and transportation problems of the future in the metropolitan area at New York. It is divided into two principal sections, the transit problem and the transportation problem. Under the transit problem the report discusses the growth of facilities and traffic, the riding habit, the periodical variation, transit congestion, trolley cars, and motor buses. The section on the transportation problem includes; the existing railroad system and outstanding needs, passenger and freight traffic, use of waterways and aviation. There is also an extensive estimate of future passenger and freight traffic.

A notable feature is the vividness and simplicity of the charts, in order that not only those interested in the technicalities of the work, but also the layman, may comprehend the data involved.

The complete plan, which this organization is preparing, is for the purpose of finding constructive methods of approaching the entire problem of civic growth. The chairman of the committee is Frederic A. Delano and the studies on traffic and transportation were made under the direction of Harold M. Lewis assisted by the engineering staff of the committee with the collaboration of Col. William J. Wilgus and Ernest P. Goodrich. Copies of the report may be obtained at the offices of The Regional Plan of New York, New York City.

Concrete and Concrete Products Control and Manufacture

Abstracts of Some of the Papers Presented at the 22nd Annual Convention of the American Concrete Institute at Chicago, Feb. 23-26

SOME of the more important papers presented at the American Concrete Institute meeting last week are abstracted below. The report of the meeting appears in the news section of this issue.

Lime in Concrete Products—Paul C. Cunnick, director of laboratories, Rock Island Arsenal, Rock Island, Ill., reported upon investigations carried on at the plant of the Northwest Davenport Cement Block Works in Davenport, Iowa, and at the plant of the Builders' Materials Co., Cedar Rapids, Iowa, on the "Effect of Lime on Concrete Products."

Briefly summed up, the general indications of test results are: (1) Appearance of product was improved by all percentages of lime. (2) Up to 40 per cent by weight hydrated lime gave an average increase in strength of approximately 1 per cent for each pound of lime added per sack of cement; aged lime putty gives considerable increase in strength, also much quicker set than equivalent amounts of hydrate; and all percentages of lime tested show increase in strength from 28 days to 6 months of age. (3) Determined by the standard immersion method, absorption increased uniformly from 6.2 per cent without lime to 7.5 per cent with the maximum lime content used; and determined by impounding water on one face, absorption is not increased by the use of lime. (4) Permeability as determined by impounding water on one face is eliminated by the use of 20 per cent or more of hydrated lime or equivalent lime putty. (5) Penetration of dampness into the product decreases as the lime is increased.

Effect of Curing Conditions on Compressive Strength of Concretes and Mortars—Between 600 and 700 compressive tests were made on specimens cured under a great variety of conditions and the results were included in a paper entitled "The Effect of Varied Curing Conditions on the Compressive Strength of Mortars and Concretes," by Herbert J. Gilkey, associate professor of civil engineering at the University of Colorado. The tests included investigations of delayed moist storage with and without the mold left on; varying periods of moist storage by removal from storage prior to test; intermittent dipping continued for varying numbers of days; intermittent soaking and drying for varying numbers of days; changes in weight due to gain and loss of water in curing; phenomena of autogenous healing as effected by the curing conditions between tests and retest.

Professor Gilkey came to the following conclusions as to the tests: That concrete kept moist 7 days after placement will give a 28-day strength about 65 or 70 per cent of the standard 28-day specimen in the same condition and that concrete kept moist for 14 days will develop about 88 per cent of the standard; that intermittent wetting or sprinkling is not as effective as the genuine moist curing unless the wetting be thorough enough to keep concrete moist during the interval between wetting; that early drying out will probably be permanently detrimental to the concrete; that concrete moist-cured will develop from 1.5 to 3 times a 28-day strength of dry-cured concrete if both be in the same condition at test; that concrete tested wet when dried out gains in compressive strength from 10 to 40 per cent depending upon the mixture, degree of drying, etc. (a good average value for typical concrete mixtures under average conditions may be taken conservatively as 15 to 20 per cent); that moist storage is more effective to wet-mixed concrete than to concrete of drier mixes; that leaving forms on in building construction probably assists in curing, though too much reliance should not be placed upon it as evaporation can still occur from the upper surfaces; that special precautions should be taken in building construction to avoid drying out, especially if heat be used to prevent freezing; that it is probable that concrete in buildings, especially those erected in cold weather, is weaker than the tests on moist-cured samples indicate; that there is some proportional comparison between the strength change and moisture-content change; that there exists no relation between 7-day and 28-day strength that will apply to variable curing conditions; that there is possible the formulation of a general law or basic principle that will enable the concrete practitioner to predict with reasonable accuracy the strength of an otherwise known concrete under a variety of known or assumed curing conditions.

Illustrative of this last conclusion, Professor Gilkey offered a universal curing diagram showing compressive strength curves in per cent of the strength of 28-day standard concrete, specimens tested dry after moist storage, tested wet after moist storage, tested dry after dry storage, and tested wet after dry storage.

Extensibility of Concrete—In a paper on the "Extensibility of Concrete," by W. K. Hatt, head of the school of civil engineering of Purdue University, there were recorded some measurements of the shrinkage and expansion of concrete under various conditions of exposure, and data were presented on the ability of concrete to undergo extension without the appearance of surface fissures. Both plain concrete and that reinforced with fabric reinforcing from 0.26 to 0.33 per cent were observed. A crack survey of the surfaces of the beams under fatigue classified surface fissures into microscopic fissures about 0.0004 in. in width and those seen with the unaided eye which were about 0.0015 in. in width. The tests indicated that the extensibility of 1:2:3 concrete before microscopic fissures appear is 0.01 per cent and at fissures visible to the unaided eye 0.018 per cent.

The conclusions which Professor Hatt drew from the experiments were that "mesh reinforcement will postpone the appearance of the eye visible fissures and lessen the defects arising from poor manufacture and curing of concrete. It follows that reinforcing in small amounts should be of substantial advantage in maintaining the integrity of concrete surfaces. The investigation covered concrete made with gravel aggregate and

under unfavorable curing conditions." Other conclusions arrived at include:

"Without restraint concrete may shrink upon drying 0.05 per cent and swell when wet 0.01 per cent. Reinforcing may reduce the gross changes of length one-half. A change of temperature of 100 deg. F. would produce a change of length of 0.05 per cent. Restraints will modify these values, as, for instance, the friction of the subgrade under a concrete pavement or the restraint of a wet core upon the drying surface of the concrete beam. The ability of ordinary concrete to withstand surface deformations is below the measure of 0.02 per cent. Fissures are, therefore, likely to result from restraint, and the problem is to lessen surface movements by proper proportioning and curing.

Relation of 7- to 28-Day Concrete—That there exists a definite relation between the 7-day and the 28-day strength of concrete secured under approximately standard conditions, and the expression of that relation in a definite equation, composed the essence of a paper presented by W. A. Slater, engineer-physicist of the Bureau of Standards, Washington, D. C., on "The Relation of 7-Day to 28-Day Compressive Strength of Mortar and Concrete." The equation $f'_c = f + 30\sqrt{f}$ was arrived at as the result of field tests carried on at Camden, N. J., and Newark Bay, N. J., under the sponsorship of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete. Mr. Slater's paper was in the main a tabulation and analysis of varied tests at 28 days plotted against the expected strength, using the equation above. Most of the data were taken from the publications of the Structural Materials Research Laboratory of the Lewis Institute, but enough from other sources to indicate that the relation pointed out was found to apply to other data. In most cases the strength reported represented the average of five tests of a kind for both the 7-day and the 28-day ages.

In the investigation, a wide variety of test specimens was used. Tests were made upon concrete made from different materials, different proportions of the same materials, different water ratios when the proportions were kept the same, specimens steam cured, specimens made of cement with varying degrees of fineness, and specimens made with a variety of powdered admixtures used in different percentages. There was also included a graph prepared to determine the effect of curing conditions on the relation of the 7-day to the 28-day strength. Mr. Slater said in conclusion:

The data involve many of the variables which may affect the compressive strength of concrete. Yet the results are sufficiently concordant to warrant the conclusions that within the limits of accuracy required on construction work, the 28-day compressive strength of concrete may be predicted from the 7-day compressive strength by means of Equation 1 (the equation cited above).

If Equation 1 is to be used to predict the 28-day strength of field specimens tested at 7 days it will be important that the field specimens be placed in damp sand as soon as possible after they are made in order to avoid the effect of variations in the early storage conditions on the 7-day strength.

The use of Equation 1 for predicting the 28-day strength would not remove the necessity of making 28-day tests before the beginning of construction as a gage of the suitability of materials and proportions proposed for use.

Soaps as Integral Waterproofing—Soaps added in small amounts as integral waterproofing to cement mortar and concrete diminish the absorption of water by capillary action and lessen the permeability to water under pressure. The compressive strength is not materially affected provided the waterproofed product is kept damp continuously until it gains the requisite strength and provided the soap is not one which causes foaming in the concrete mixer with entrainment of air in the finished product. If concrete containing soaps dries before it has attained the desired strength, it will always remain weak because being waterproofed, water will not be able to gain free access to the interior of the mass and continue the hardening process.

These are the principal conclusions reached in a paper on "Soaps as Integral Waterproofings for Concrete," by Alfred H. White, professor of chemical engineering of the University of Michigan, and John H. Bateman, professor of highway engineering, Louisiana State University.

This paper included a review of all the principal literature on the use of soaps as integral waterproofing and experiments made by one of the authors. Conclusions drawn from their experiments are given below:

Soaps added in the concrete mixer are effective in preventing the absorption of water by capillary action, even when added in very small amounts if they are added in such a form as to insure extremely fine subdivision and dispersion in the finished concrete. As little as 0.05 per cent of fat acid in the form of soap based on the weight of concrete is sufficient if it is finely divided and uniformly distributed, and if the concrete is well made and not cracked. Soaps will not in themselves entirely prevent the penetration of water under even rather slight pressure but they will be of assistance. If the concrete is well made and thoroughly cured, the colloid near the surface swells when it becomes wet and fills the pores so completely that the penetration of water may stop before the water has progressed many inches from the surface, even if the concrete is not waterproofed.

This ability of plain concrete to resist water comes only with time and the development of sufficient colloid to fill the pores. Concrete which becomes dry within a few days after it is made does not possess sufficient development of the colloid to prevent the absorption of water. Soaps are as effective in fresh concrete as in that which has aged and assist in preventing the penetration of water even under pressure. Insofar as the concrete becomes wet it expands, and it contracts when it becomes dry, irrespective of the presence of soaps, which are effective only in preventing access of water.

The strength of concrete is not impaired by the addition of soaps in the proportions stated above, provided it is kept damp continuously after pouring until it has attained the desired strength and provided the soaps have not caused foaming and consequent entrainment of air. The strength of concrete of a given composition is a function of the amount of cement which has reacted with water and may be plotted as a function of the water held in combination. Plain concrete which has been allowed to dry and subsequently becomes wet will resume the hardening process and gain in strength. Concrete containing soaps gains strength very slowly after it has once become dried because it resists the absorption of water. Special pains must therefore be taken to keep concrete containing soaps damp for at least seven days if it is to equal plain concrete in strength.

The shrinkage of concrete on drying is a function of the quantity of cement and the degree of its hydration and will not be lessened by the use of soaps. The same precautions must therefore be taken to prevent shrinkage cracks in waterproofed as in plain concrete. Soaps are not able to prevent the penetration of water through cracked concrete. They will retard the penetration of water into dry concrete, and therefore will be helpful in preventing volume changes due to alternate exposure to wet and dry conditions in structures such as stuccos and pavements. If the concrete is kept damp, as all concrete should be, until it is properly cured, there should be only slight diminution in strength due to the waterproofing. Conditions may readily arise in service where the waterproofed concrete will be distinctly stronger than the plain concrete. A concrete slab wet and expanded on one side and dry and contracted on the other side is subject to powerful shearing stresses which weaken it materially. A slab which is waterproofed should not absorb water to nearly the same extent and therefore should not be weakened so much under similar adverse conditions.

Recent Rock Tunneling Methods, Illinois Central R.R.

Longest of Three Rock Tunnels on New Line Through the Ozark Hills Exemplifies Best Modern Equipment Practice

INTELLIGENT variation of methods is securing excellent progress with very simple outfits in driving three railway tunnels through rock in the Ozark hills of southern Illinois. The tunnels are on the new direct line to Metropolis on the Ohio River (*Engineering News-Record*, Dec. 4, 1924, p. 918) of the Illinois Central R.R., and they are 800 ft., 6,900 ft., and 2,600 ft. long. They are all single track tunnels of the common 18x26-ft. section as shown by the accompanying drawings. The 800 ft. tunnel is on a 1½-deg. curve and an 0.25 per cent grade and the longest tunnel has 110 ft. of 1½ deg. curve at one end but is level. The third tunnel is on tangent and level. It is only in the longest tunnel that methods and plant call for particular mention.

In planning the line, tunnel lengths were determined on the assumption of balancing excavation and fill. As this plan worked out, very considerable approach cuts were called for, about 75 ft. at portals. In the shorter tunnels it was practicable to complete the approach cuts and drive from the portals but with this plan for the 6,900-ft. tunnel driving would be delayed too long to finish in time so a center shaft was planned. It was calculated that, working two ways from this shaft, a 10 ft. square drift could be put through by the time the approach cuts were up to the portals. Then the enlargement of section could be rapidly handled by shovels and hauling to the portals.

On the 6,900-ft. tunnel a 17x14 ft. shaft was sunk just clear of the tunnel and to a depth below subgrade.

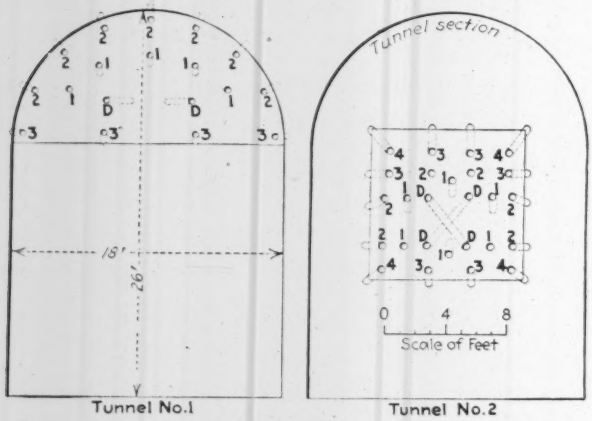


FIG. 1—DRILLING CHART AND SECTION OF ILLINOIS CENTRAL R.R. TUNNEL

From this shaft a full width drift 10 ft. high was driven both ways 150 ft. and then narrowed to 10 ft. wide as indicated by Fig. 1. A compressed-air shovel loader was put into each heading, riding on the inside rails of a double-track spoil railway with two storage-battery locomotives. A pneumatic hoist switches the cars at the faces; 1 cu.yd. cars are operated in 12-car trains.

The drilling chart is given by Fig. 1. The four cut holes *D* are drilled to a common point in the center and are fired direct. These loads move the core far enough to prevent any interference with the swell of the remaining rock. The other holes are fired in the order of their numbers. The "lifters," or four holes in the bottom, are loaded with the heaviest charges in order to move all the muck back from the face a short distance, so as to provide room for the drillers to resume operations. With 11-ft. drill steel and 4 to 7½ lb. of 40 per cent dynamite per cubic yard of rock, a round pulls about 8 ft. Three eight-hour shifts per day have been worked continuously. For the period of approximately seven months that has elapsed since the 10x10-ft. drifts were started the combined average progress made for the two has been 28 lin.-ft. per day. The best progress was during November, when an average daily advance of 32.1 lin.ft. for the two headings was recorded. The rock penetrated has been generally sound, but some 1,700 ft. of drift in shale has had to be timbered.

FIG. 2—PORTAL OF I. C. R.R. TUNNEL NO. 3, 2,600 FT. LONG

The compressed air power plant consists of three 200-hp. Diesel engines connected to three compressors the combined capacity of which is 2,620 cu.ft. of free air per minute, delivered to the working faces at 125 lb. pressure. Two 75-kva. alternators and one 150-hp. generator, operated by two 100-hp. Diesel engines, furnish power for the motor-driven ventilating fans, for lighting and for charging the storage batteries of the electric locomotives. Another 100-hp. Diesel engine furnishes power for operating the hoist.

The construction work on this 166-mile line, which is about 50 per cent completed, is under the direction of E. L. Cruger, engineer of construction, Illinois Central R.R., with T. H. Robertson as assistant engineer in charge. The 800- and 6,900-ft. tunnels are under J. W. Swartz, resident engineer, while the 2,600-ft. tunnel is on the residency of P. R. Henderson. The general contractor for the three tunnels is A. Guthrie & Co., St. Paul. This firm is handling the 6,900-ft. tunnel, with Grant, Smith & Co., of St. Paul, as subcontractors for the 800-ft., and R. S. Morrow & Son, of Omaha, Neb., for the 2,600-ft tunnel.

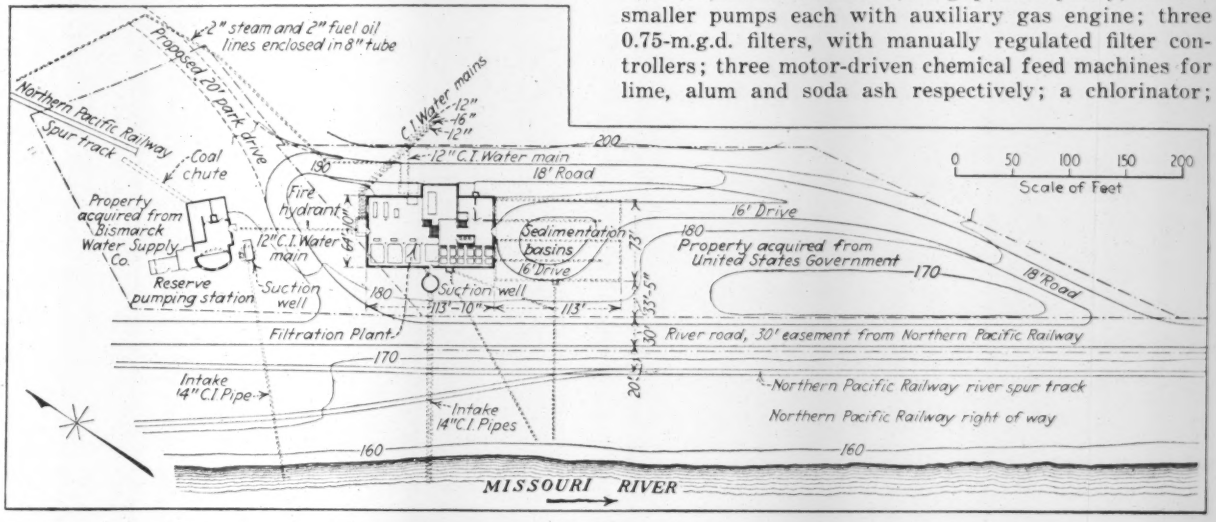
Single Building Houses Bismarck's New Pumps and Filters

Diesel Engine Drives Generator for Motor-Operated Centrifugal Pumps, with Gasoline Engines Held in Reserve

By Thorn Dickinson

Formerly Assistant to the City Engineer, Bismarck, N. Dak.; Now Construction Engineer with Ulen Contracting Co., Athens, Greece

AMONG extensive improvements made in 1923-4 to the water-works system of Bismarck, N. Dak., are two features of particular interest, both of which have proved entirely satisfactory in operation. They are: (1) A power plant, pumping station, and 2½-m. g. d. water softening and filtration plant under one roof, for operation by two or three attendants; and (2) utilization of domestic service pumps, in connection with high-level storage reservoirs, to supply fire demands at increased pressure and at three times the capacity of the filtration plant.



LAYOUT OF PUMPING AND WATER TREATMENT PLANT FOR BISMARCK

The new plant was constructed by the city of Bismarck to replace pumping stations and clarification works acquired when the city took over the water-works system of the Bismarck Water Supply Co. in 1923. The company's works included a pumping plant at the bank of the Missouri River, which is the source of supply; a clarification works situated at high-level reservoirs on a bluff 200 ft. above the river level; and a booster pump station midway between the river and the city, which are two miles apart.

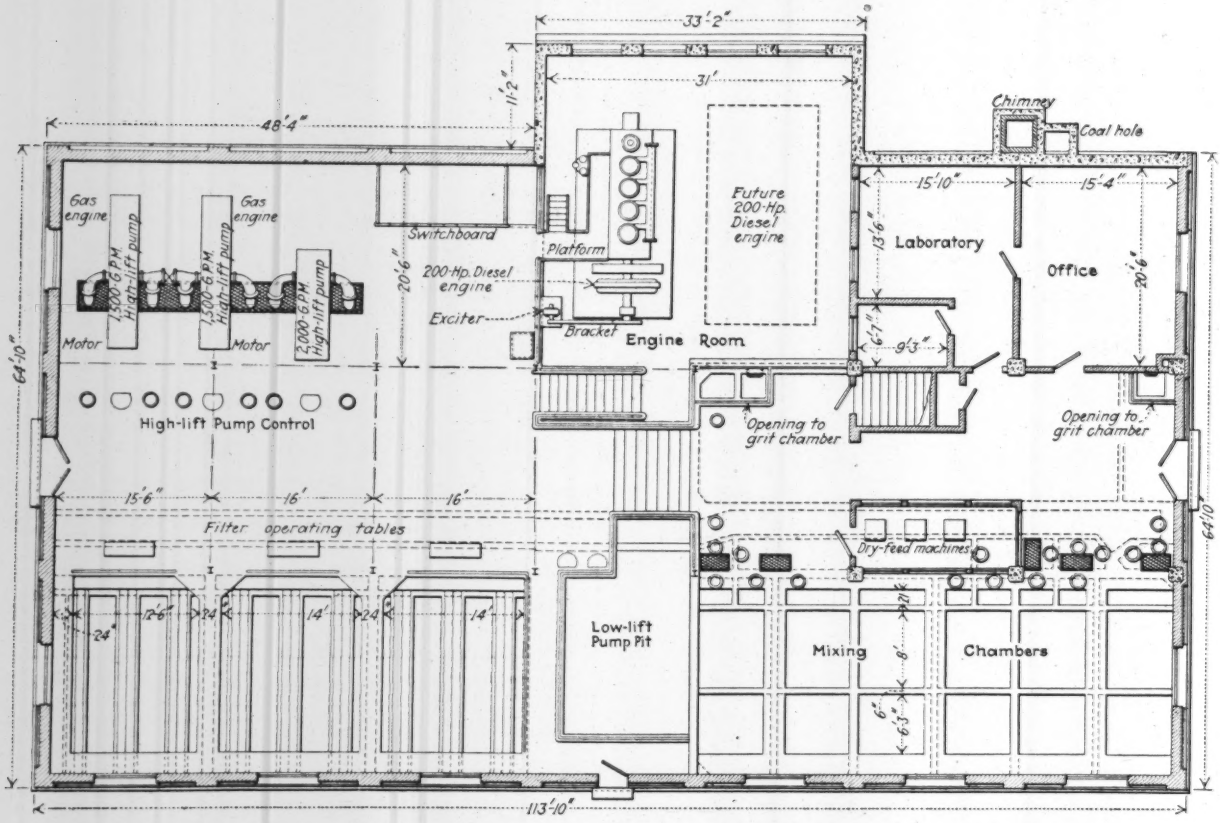
Operating the old system required an engineer at the pumping station, which was supplied with power by the local utility company, and an attendant at the clarification works, while in case of fire a third man was dispatched from the city by automobile to start the fire pump in the booster pump station. During the summer months, when water consumption is high, the two regular attendants worked unreasonably long hours, sometimes eighteen per day. The obvious disadvantages of this arrangement suggested that the new plant, which was required because of the inadequacy of the old works, be so constructed that three men, working together in one place for reasonable hours, could handle all the work of pumping, purification and fire service.

The new plant was therefore located at the pump house site, and designed as a unit, with Diesel engine, generator and switchboard, high- and low-lift pumps, filters and mixing chambers, all under one roof, without partition walls between them, and so placed as to require the fewest possible steps on the part of the attendants. The accompanying plan indicates the general layout, which was in part determined by a long and narrow site, and the necessity of provision for future enlargement.

The equipment includes a 200-hp. Diesel engine direct-connected to a 135-kw. generator and a 7-panel switchboard; two motor-driven low-lift centrifugal pumps of 1,500- and 2,000-g.p.m. capacity (2.16 and 2.88 m.g.d.) respectively, the larger with auxiliary gas engine; three motor-driven high-lift centrifugal pumps, two of 1,500- and one of 2,000-g. p. m. capacity, the two smaller pumps each with auxiliary gas engine; three 0.75-m.g.d. filters, with manually regulated filter controllers; three motor-driven chemical feed machines for lime, alum and soda ash respectively; a chlorinator; minor auxiliary equipment; and a well equipped laboratory. As this equipment is all of standard type, no detailed description will be given in this article.

The construction of the plant for unit operation has proved to be entirely satisfactory. Three men readily handle all the work, including the cleaning of the sedimentation basins, care of the grounds, and a daily chemical and bacterial test of the water. During the summer months, when 12 to 16 hr. per day of pumping is required, they are able to divide up their time so that each will average not more than 10 hr. per day. In case of accident or emergency in any part of the plant, all the men are available, instead of being scattered about where they can be of no mutual assistance. Unified control of the whole process of furnishing water to the mains saves the water-works superintendent the troubles which inevitably arise in co-ordinating different departments.

No difficulties of consequence have developed in operating the plant. The placing of the filters and mixing chambers, containing large bodies of cold water, in the same room with the machinery, has caused no trouble

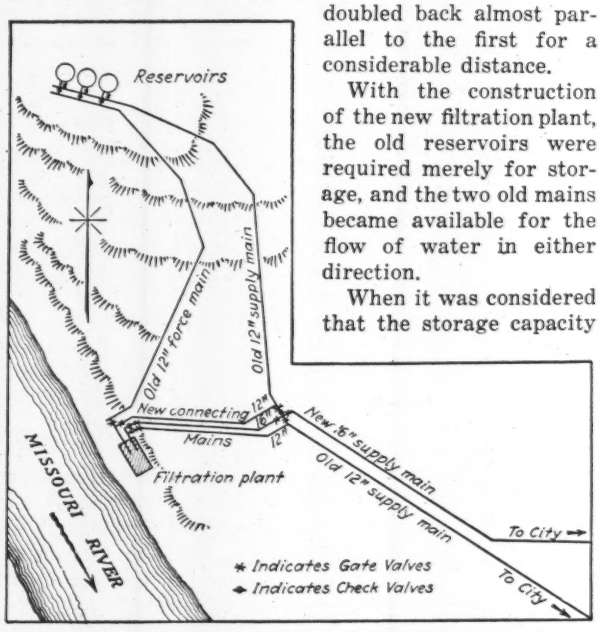


MAIN FLOOR OF PUMPING AND FILTRATION PLANT FOR THE CITY WATER-WORKS OF BISMARCK
The clear well is beneath the filters and high-lift pumps.

whatever from moisture, either in the summer or winter. Additional heating is no doubt required during the winter, but this appears to be small in amount, and in the case of the mixing chambers probably assists the chemical reactions involved in water softening.

A second feature of interest is the provision for using the domestic-service high-lift pumps as fire pumps at increased pressure, the supply coming from high-level storage reservoirs, and affording a fire flow triple the capacity of the filtration plant. Special conditions, which might not often be met with, made this arrangement practicable. It would appear, however, to be of particular advantage in any plant supplying a small city, which, unlike a large city, may require several times the normal domestic water supply for fighting a serious fire. The construction of a filtration plant of sufficient capacity to take care of such emergencies is usually out of the question, and the maintenance of enough fire engines to provide fire pressure for the number of fire streams needed in fire fighting is prohibitive in cost.

In the case of Bismarck, the property taken over by the city from the private company included three high-level covered reservoirs of a combined capacity of 3,000,000 gal., from which the water flowed by gravity to the city, with a static pressure in the business district of about 55 lb. per sq.in. This large capacity in connection with an unfailing source of supply was originally provided in the hope of clarifying the Missouri River water by sedimentation, which, needless to say, was far from being realized. A 12-in. force main led from the pump house to the reservoirs, and a second 12-in. main from the reservoirs to the city, the location of the reservoirs being such that the second main doubled back almost parallel to the first for a considerable distance.



PIPE CONNECTIONS BETWEEN BISMARCK FILTRATION PLANT RESERVOIRS AND CITY

With the construction of the new filtration plant, the old reservoirs were required merely for storage, and the two old mains became available for the flow of water in either direction.

When it was considered that the storage capacity

of 3,000,000 gal. would permit a flow of 5,000 g.p.m. for a period of ten hours, which was the requirement of the fire underwriters for the combined domestic and fire flow of a city like Bismarck of less than 10,000 population, it was determined to utilize the old reservoirs and mains for this purpose, leading the water back from storage through the plant, and increasing its pressure to 100 lb. per sq.in. by means of the domestic service pumps, without any investment in fire engines or special pumping equipment. The plans were drawn to provide a header in the pipe gallery, connecting with the two mains from the reservoirs, and with the suction lines of each of the high-lift pumps. In case of a fire requiring the maximum flow, each pump receives water from the reservoirs under domestic pressure on its suction side, and delivers it under fire pressure to a discharge header connecting with the mains leading to the city. As this header also connects with the reservoir mains for filling the reservoirs under normal conditions, a valve is provided in the pump house, together with a check valve at an outside cross-connection, for shutting off the reservoirs from the distribution system. Ordinarily this valve is left open, enabling the city to receive its domestic supply from the reservoirs when the plant is not in operation.

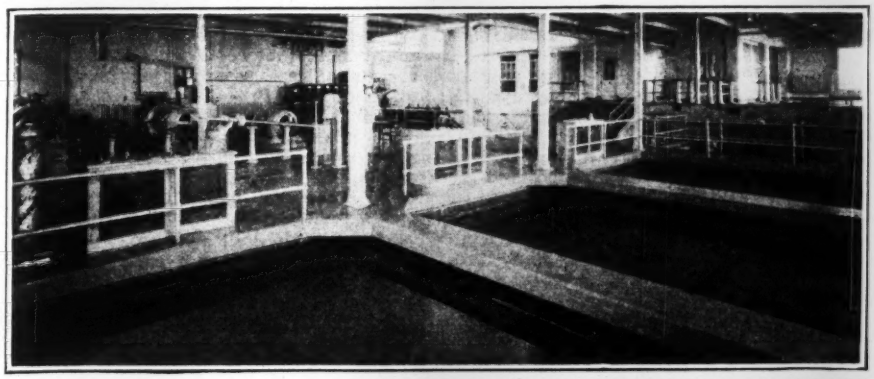
In addition to this special arrangement the common provision is made of a series connection between two of the high-lift pumps for supplying water directly from the filtration plant at fire pressure.

No serious fire has occurred since the completion of the plant, but in tests and small fires the arrangement has proved to be satisfactory. Upwards of 5,500 g.p.m. are readily supplied, which is sufficient for from 12 to 15 fire streams in addition to the maximum domestic consumption. The auxiliary gas engines drive two of the pumps when all three are required, the Diesel engine having power for but one high-lift and one low-lift pump. The gas engines are also available for operating the pumps for ordinary domestic consumption in case of breakdown of the Diesel engine.

The plant is a part of additions made to the privately owned water-works system, which was taken over by the city after the usual legal and political battle. The cost of the old system was $273,000, and of the new work $397,000, including, besides the filtration plant, a 16-in. supply main from the plant to the city, and extensive additions to the distribution system. The population of Bismarck was 7,122 in 1920; 5,443 in 1910; and 3,319 in 1900.

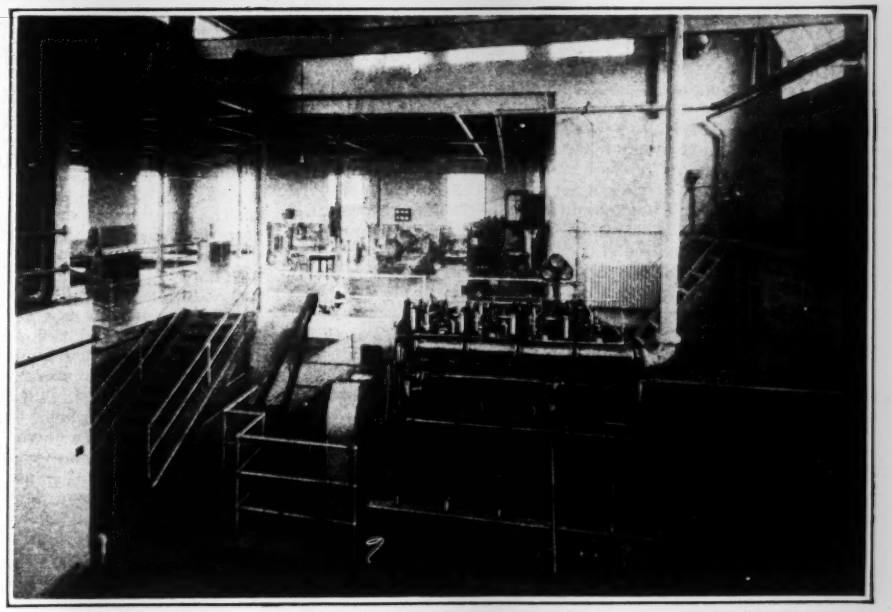
The original plant was built by the Bismarck Water Co. in 1887-88. J. Albert Monroe was designing and constructing engineer and Morison & Corthell, Chicago, served as consulting engineer. Untreated water was pumped by 3-m.g.d. pumps to two reservoirs with combined capacity of 2,000,000 gallons.

The work was designed by the writer under the supervision of T. R. Atkinson, city engineer of Bismarck, and L. P. Wolff, consulting engineer, St. Paul, Minn. Pumping equipment was supplied by the Midwest Engine Corporation and the Diesel engine by the McIntosh & Seymour Corporation. The contractor for the filters and equipment was the McFarland Engineering Co., Kansas City, Missouri.



LEFT: FILTERS AND PUMPING PLANT

Looking over filters and operating tables to high-lift pumps (left), switchboard, top of Diesel engine and platform over mixing chambers. Note absence of partitions and good natural lighting.



RIGHT: PUMPING AND FILTRATION PLANT, BISMARCK

In foreground, Diesel engine which generates current for low-lift pump motors. Right background, high-lift motor-driven pumps, with gasoline engine auxiliary on two. At left, filter operating tables with filters beyond.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Bequests to American Society of Civil Engineers

Sir—The recent successful Annual Meeting of the American Society of Civil Engineers indicated, through its Division meetings, the development of a much broadened interest in the activities of the society. This greater activity will need constantly increasing financial support. Undoubtedly, there will be growth of membership and proportionate increase in revenue. Nevertheless one can foresee a restriction of desirable activity if the dues are to be the only source of revenue.

Many institutions lacking the age and prestige of the American Society of Civil Engineers have successfully sought endowments. In fact, reports of gifts and bequests to religious, educational, scientific and philanthropic institutions appear frequently in the public prints. Certainly the society, with its record of achievement and its hold on the loyalty of its members, is worthy of similar remembrance.

The writer is fully aware of the gifts for prize funds and of Mr. Freeman's generous offering. But there should have been many more.

Possibly the dearth has been due to the failure of the society to stimulate such offerings. An active campaign probably is not desirable. But could there not be a moderate stimulation; could not the society hold before its members the thought that such bequests are welcomed by the organization and would be a credit to those who make them? If there were established an endowment fund the existence of which would be noted in each copy of "Proceedings," the members would not forget that they ought, if blessed with this world's goods, to give some small part to the society while living or when they pass on. Once a year a list of all contributors might be published in the Year Book.

It would have to be made clear that the purpose of the fund was not to secure a few large gifts, but many modest ones. Probably many persons are deterred now from making even bequests because they feel that sums of $500 and $1,000 are entirely too small to be offered to a great organization. If the idea should prevail, however, that this was an endowment built up by devoted members no matter of what financial status, small bequests might be received in fairly large number.

Possibly I am too optimistic in believing that such a fund would grow to large proportions. What do the members of the society think? WELL WISHER.

City Engineers and Private Practice

Sir—In the article on engineering work in Fargo, N. D., *Engineering News-Record* Jan. 28, p. 152, there is a statement that has more in it than I believe the editor thought to imply or say. He says that Fargo passed an ordinance which "prevents him (the city engineer) from engaging in outside professional work," giving as a reason that the city officials want his entire time. He also says the authors of the ordinance thought "the engineer should be able to eke out a comfortable living for himself and family on the $3,600 presented him annually."

For my part I believe the ordinance does more to raise the status of the engineering profession than half of the speeches made on the subject. The apparent objection to the ordinance is that the city engineer would gain greater ability from his outside practice but the hint of low salary seems to me to be the real reason. If the city engineer puts his entire time on each problem as it presents itself he is in a better position to pass on succeeding ones. If the subject is new he can call in an engineer in private practice who has had special training, and who also has a family that he must support.

I am for the advancement of the engineering profession and adequate salaries but how are you going to get the municipal salaries raised if the private salaries are low; and how are you going to raise the private salaries if you do not protect the job! If the city engineer does all the high-class work in the vicinity what is he going to do when he leaves the office and a new man takes his job? He will have to open a real estate office or peddle insurance. Let him not fool himself and think because he did all the outside work it was because of his ability. He will find the office that he held got the most work for him.

If the city engineer has a right to do outside professional work the other engineers working for the city have the same right. The extreme of that condition is one wherein all the engineers are out of town and only the axman and stenographer are on hand for city council meetings.

I know the salary of the city engineer is small, but let such take up private practice with the opportunity for bigger salary, furnish their own offices, instruments and everything necessary, and I will venture the remark that in less than six months, more than half of them would take their old jobs back at a reduced salary.

Mt. Vernon, Wash., JOHN W. MEEHAN.
Feb. 9, 1926.

The Case of Floods and Forests

Sir—Your editorial, Floods and Forests Again, (p. 181, Feb. 4, 1926) hits the nail squarely on the head.

You might have gone further and stated that in some special cases the danger from inundations is increased by having a majority of the watershed covered with forests. It is generally true that all the works of man, clearing and cultivating the land, digging ditches, etc., tend to increase runoff, therefore increasing the danger of floods; the exception to this rule is cold climates with heavy snowfall.

Every year when there is an unusually heavy snowfall in the mountains of the northwestern states and in western Canada there follows the anxiety regarding danger of spring floods. However, the danger does not altogether depend on the amount of snow, but rather in the way it runs off. One would naturally suppose that the time of greatest danger would be the early spring when all the low lands are covered with snow; that would be a logical conclusion were it not for another controlling factor. The writer can find no record of any great inundations in early spring in the northwest and the reason for this is that the weather does not remain warm nor are rains continuous unless the weather remains warm. The real danger exists when there is a late cold spring, for example in the spring of 1894 when the highest water mark for fifty years or more was reached in the lower Columbia and Fraser Rivers. It was a cold spring up to May 24 when it turned very warm accompanied by rains and remained warm. On June 9 the waters of the Arrow Lakes and Kootenay Lake in Canada were 10 to 15 ft. above ordinary high water mark.

The greatest of floods in the Red River Valley was in 1826 when the entire valley from Minnesota to St. Andrews Rapids some 15 miles north of Winnipeg was covered with water from 3 to 6 ft. deep and 10 or 12 miles wide.

To quote from "Report, Canadian Pacific Railway, 1880" by Sanford Fleming, chief engineer, p. 265: "In 'The Red River Settlement, Its Rise and Progress' (by Alexander Ross), a work written before the inundation of 1852, we find an account of an earlier flood, of which the author was an eye-witness. This occurred in the year 1826. The water rose about 18 inches higher than in 1852, and submerged a much greater area of the level prairie. It lasted from the 2nd of May to the 15th of June."

The flood of 1861 was 2 ft. lower than the flood of 1852 or about 4 ft. lower than that of 1826. The flood of 1882 was 10 ft. lower than that of 1826 and the flood of 1916 was 12 ft. lower than that of 1826, although it is a fact that the latter flood occurred over a month earlier than those of 1826 and 1852. It is the opinion of the writer that the danger of such inundations in the future is very remote, for the reason that the natural reservoirs for the storing of large quantities of snow in the forests have been greatly reduced (see *Engineering News-Record*, July 26, 1923, p. 133.)

While it is true that the clearing of the lands and the construction of numerous drainage ditches has greatly increased the frequency and intensity of the lesser floods, in the opinion of the writer the same works have decreased the danger of a ruinous inundation.

Winnipeg, Man., J. G. SULLIVAN,
Feb. 15, 1926. Consulting Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Concrete Institute Holds Well-Attended Meeting

Twenty-second Annual Convention Stresses Papers and Discussions Not Reports

American Concrete Institute at its 22nd annual convention in Chicago, Feb. 23-26, drew probably the best consistent attendance in its history. Over 600 members were registered and each of the eight meetings was exceptionally well attended. Rarely were there less than 300 at a session and in one evening, when a demonstration of practical application of stucco was given by O. A. Malone, a California stucco contractor, more than 500 interested spectators were present. No time was given to social events nor to simultaneous sessions. There was an excursion one afternoon to the Wacker Drive, the double-deck highway now nearing completion on the south side of Chicago River near the lake.

Committee Reports

In marked distinction to other meetings of the Institute, very little attention was given last week to committee reports on specifications. One committee presented a purchasing specification for aggregate. Committee E-5, on aggregate, presented a purchasing specification for aggregate. Committee D-5, on estimating concrete, made a progress report and D-4, on concrete staves, presented concrete stave standards, which were accepted to go to letter ballot. P-1, on standard concrete building units, submitted a method for testing concrete masonry units; P-6, on concrete plant operation, a report entitled "How to Cure Concrete Building Units"; S-1, on chimneys, a progress report on reinforced-concrete chimney research; and E-3 on research, an extended report on the status of research in concrete. This latter report, read by H. M. Gonnerman cited the results of questionnaires to over 200 laboratories, that are working in concrete. The report includes information on researches now under way and those needed. It was noted that more attention is now being paid to plain concrete and materials of concrete than to reinforced concrete. The report also had a bibliography of all the recent literature on concrete. Committee E-6, on destructive agents and protective treatments, cited some further instances of the destruction of concrete due to improper water content and in one case to the use of too fine sand.

General Papers

One evening was devoted to the subject of earthquakes. H. M. Hadley, district engineer of the Portland Cement Association at Seattle, elaborated a paper which he read three years ago on the Japanese earthquake by citing his observations of the effect of the Santa Barbara earthquake on structures. He re-emphasized the necessity for an integrated structure, no matter what material it be built of. Dr. Arthur L. Day, director of the Geophysical Laboratory at Washington, delivered an absorbing lecture on earthquake phenomena. Mr. Day's main thesis was that while earthquake occurrence is not predictable as to time, it is fairly predictable as to location, and that to design a structure in or near a location where an earthquake is bound some time to occur without taking the precautions which have been found necessary to resist earthquakes is inexcusable. He remarked, however, that on the West Coast where such precautions are indicated, the observance of proper rules of design is generally neglected. He absolved Santa Barbara since the earthquake from this criticism.

Concrete Proportioning

Four papers relating to the newer methods of proportioning and placing concrete were read, each describing a different method. R. B. Young, senior assistant laboratory engineer of the Hydro-electric Power Commission of Ontario, recounted his seven-year experience with water-cement control on that commission. As has been frequently reported in *Engineering News-Record*, Mr. Young has instituted in this work a water control method whereby the proper amount of water is established by fairly rough laboratory investigation of the aggregate and the workability is assured by adding cement and water in proper proportions rather than water itself. His paper

(*Concluded on p. 377*)

Engineering Fifty Years Ago

From *Engineering News*, March, 1876

THE Legislature of Montana Territory has voted in favor of giving the Northern Railway Company a subsidy of three and a half millions of dollars to aid in promptly extending the road from Bismark five hundred miles westward, and the Utah Northern narrow-gage railroad a subsidy of $1,500,000. Montana now has no railroad. The extension of the Northern Pacific into Montana will give that territory an instant and powerful stimulus in growth, as it will open her rich mines and other valuable possessions to market and to settlement. No doubt the territory would receive the worth of its money within less than a year; and it would be repaid many times over in ten.

Cast-Iron Pipe Standards to Be Considered

New Joint Committee Under Auspices of American Engineering Standards Committee

Announcement has just been made by the American Society for Testing Materials of the formation of a representative committee on cast-iron pipe which will undertake a general program of unifying existing specifications for cast-iron pipe into a consistent set of nationally recognized specifications. This committee, which will be officially known as the Sectional Committee on Standard Specifications for Cast-Iron Pipe, is being sponsored by the American Gas Association, American Society for Testing Materials, American Water-Works Association and New England Water Works Association and will function under the procedure of the American Engineering Standards Committee.

Complete Announcement

The text of the announcement is as follows:

"This development is the outcome of the submission two years ago by the American Gas Association of its Standard Specifications for Cast-Iron Pipe and Special Castings to the American Engineering Standards Committee for their approval as American Standard Specifications. It became evident that consideration of these specifications for such approval would involve the standardization of cast-iron pipe in general, and at a conference held under the auspices of the American Engineering Standards Committee, which was very widely representative of industries that produce and use this product, it became clear that whereas dimensional standardization was principally involved in the specifications for gas pipe, a broader treatment of the whole problem was essential if results of the greatest benefit were to be obtained. Thus at this conference the need of a study of the quality of metal in cast-iron pipe and the problem of suitable coatings were emphasized as ones of primary importance to water works engineers. Recently developed methods of producing cast-iron pipe must be taken into consideration.

The Project Broadened

"The American Gas Association was entirely willing to have the project broadened, and upon the recommendation of the conference the American Engineering Standards Committee agreed to set up a broad program of standardization of cast-iron pipe under its auspices and invited the American Gas Association, American Society for Testing Materials, American Water Works Association and New England Water Works Association to sponsor the organization of a representative 'sectional committee' to carry on the

actual work of investigation and standardization.

"The scope of the work has been defined as follows: Unification of specifications for cast-iron pipe, including materials; dimensions; pressure ratings; methods of manufacturing (including such new developments as centrifugal casting), in so far as they may be necessary to secure satisfactory specifications; elimination of unnecessary sizes and varieties; consideration of the possibility of developing a coordinated scheme of metallic pipe and fittings applicable to all common mediums; and methods of making up joints in so far as they are determining as to the dimensional design of cast-iron pipe.

"The types of cast-iron pipe to include: bell and spigot pipe; flanged pipe; flanged and bell mouth fittings and wall castings; pipe elbows, tees, Y's, return bends, and other fittings not now included in standard lists; cast-iron pipe threaded for flanges or couplings; soil pipe and other light types of cast-iron pipe and fittings. The standardization is not to include methods of installing pipe and similar matters, except as to the making up of joints in its relationship to the dimensional standardization of pipe and fittings, as noted above.

"The sponsors have been engaged in the details of organizing the sectional committee, which will comprise representative producers and users of cast-iron pipe, and independent technical experts. Eleven technical societies and associations are represented in the work of the committee."

COMMITTEE PERSONNEL

The sponsors announce the personnel of the committee as follows:

Am. Gas Assoc.; Walton Forstall, engineer of distribution, United Gas Improvement Co., Philadelphia, Pa., H. E. Bates, assistant chief engineer, Peoples Gas, Light and Coke Co., Chicago, Ill., and C. C. Simpson, Jr., general superintendent, Dept. Mains and Services, Consolidated Gas Co., New York City: Am. Ry. Eng. Assoc.; C. R. Knowles, superintendent, water service, Illinois Central R.R., Chicago, Ill., alternate, C. P. Van Gundy, water engineer, Baltimore and Ohio R.R., Baltimore, Md.: Am. Soc. C. E.; F. H. Stephenson, assistant superintendent, Detroit Dept. of Water Supplies, Detroit, Mich.: Am. Soc. M. E.; J. E. Gibson, manager and engineer, Commissioners of Public Work, Charleston, S. C.: Am. Water Works Assoc.; Thos. H. Wiggin, consulting engineer, New York City; Wm. H. Brush, deputy chief engineer, Dept. Water Supply, Gas and Elec., New York City, W. C. Hawley, chief engineer and general superintendent, Pennsylvania Water Co., Wilkinsburg, Pa., E. E. Wall, water commissioner, St. Louis, Mo., and F. A. Barbour, hydraulic and sanitary engineer, Boston, Mass.: National Fire Protection Assoc.; C. W. Mowry, director, Factory Mutual Laboratories, Boston, Mass.: U. S. Bureau of Standards; I. J. Fairchild, Washington, D. C.: Underwriters' Laboratories; A. W. Claussen, assistant engineer, Chicago, Ill.; Am. Soc. for Testing Materials; Richard Moldenke, consulting metallurgist, Watchung, N. J., and S. R. Church, technical adviser, The Barrett Co., New York City: New England Water Works Assoc.; F. A. McInnes, consulting engineer, Boston, Mass., C. W. Sherman, consulting engineer, Boston, Mass., and W. R. Conrad, Burlington, N. J.: Manufacturers Standardization Society of the Valve and Fittings Industry; C. R. Wood, Philadelphia, Pa.: American Cast Iron Pipe Co.; W. D. Moore, president, Birmingham, Ala.; J. B. Clow and Sons; Kent S. Clow, vice-president, Chicago, Ill.: Glamorgan Pipe & Foundry Co.; A. M. Campbell, Lynchburg, Va.: Lynchburg Foundry Co.; W. G. Hammerstrom, Lynchburg, Va.: National Cast Iron Pipe Co.; A. M. Ford, assistant engineer, Birmingham, Ala.: R. D. Wood and Co.; Walter Wood, Philadelphia, Pa.: Warren Foundry and Machine Co.; Shellman B. Brown, superintendent, Phillipsburg, N. J.: U. S. Cast Iron Pipe and Foundry Co.; N. F. S. Russell, president, D. P. Hopkins, vice-president, and D. B. Stokes, general sales manager, Burlington, N. J.

Water-Works Men and the 1925 Federal Income Tax

Without venturing positive advice to employees of municipally owned water-works, the Federal Income Tax Committee of the American Water Works Association, through Beekman C. Little, secretary, Rochester, N. Y., expresses the following opinion in a circular dated March 1: "It would appear that such employees, if they file an income return, could properly claim their salaries to be exempt from Federal tax, for the income tax blanks now being given out at the U. S. Internal Revenue offices again contain under the heading, 'Items Exempt from Tax' the following: '(i) Compensation paid by a State or a political subdivision thereof to its officers or employees.'" Congress has relieved any and all municipal employees from payment, and from penalties for nonpayment, of income taxes under the law of 1924 or earlier laws, as noted in our issue of Feb. 25, p. 339, but the old question whether water-works is a governmental function, or non-governmental as claimed lately by the Internal Revenue Department remains unsettled.

Major Gardner's Body Found in Mississippi River

In Cow Island Bend in the Mississippi River, near the place where the steamer *Norman* sank on May 8, 1925, the body of Major William M. Gardner was found Feb. 19, 1926. Major Gardner was born in Augusta, Ga., in 1868. On 1890 he became an instrumentman in the Mississippi River Commission and in 1892 became U. S. assistant engineer on levee work on the Mississippi River, in charge of the Yazoo Levee District and the White River District under the Mississippi River Commission. At the time of the *Norman* disaster he was in charge of the river work being inspected by the Mid-South Engineers' Convention.

Phelps Johnson Dies

Eminent Canadian Bridge Engineer—Took Active Part in Design of Quebec Bridge

Phelps Johnson, of the Dominion Bridge Co., died at Montreal on Feb. 20, at the age of 75. For more than a quarter century he had occupied a unique position of distinction in Canadian engineering circles, and was perhaps the most widely known and respected engineer in the Dominion. Born in Warwick, N. Y., on Oct. 23, 1849, Phelps Johnson went through his school and academy training in Massachusetts, and at 17 entered the structural shop of the P. M. Hawkins Iron Works, of Springfield, Mass., as draftsman. He remained with this company for 12 years, and then put in three years of service as assistant engineer with the Wrought Iron Bridge Co. of Canton, Ohio. Early in 1882 he went in a similar capacity to the Toronto Bridge Co., of Toronto, Ont., and with this change he began his career in the country to which the remainder of his life was devoted.

Little more than a year after going to Toronto he became manager and engineer of the Toronto Works of the Dominion Bridge Co. Five years later he was promoted to the position of chief engineer, going to the company's main plant at Lachine, near Montreal. In 1891 he took over the duties of general manager; he was made managing director in 1910 and president in 1913. Thus, he occupied a leading position in the Dominion Bridge Co. from the time of its inception until he retired from active business in 1919.

This period covered Canada's growing time in the construction of railways and highways. Nearly all the notable bridges of the country were constructed in this period, and Mr. Johnson had to do with most of them. These structures, the success of the company, and his originality in solving difficult steel construction problems and devising new erection methods, all are witness to his genius.

QUEBEC BRIDGE CONSTRUCTION

In the Quebec bridge, Phelps Johnson built his greatest monument. It was he who devised the K-truss which simplified the great problem presented by that project and diminished its hazards in notable degree. The proposed 1,800-ft. cantilever structure above Quebec placed an unprecedented problem before engineers; it was necessary to develop a practicable design that could be built safely, and with practicable means. One of his close co-workers describes the situation:

"That engineering monument, the Forth Bridge, of practically the same span, had been built with consummate skill plate by plate at the site. Climatic and industrial conditions in Canada prevented this method from being followed, and it was necessary to construct the Quebec Bridge of mem-

bers built in the shops. Traffic requirements were such as to call for a bridge some 2½ times heavier than the Forth, so that members of very large size were needed, which would have been exceedingly difficult to handle if the bridge were constructed with any of the ordinary arrangements of web bracing. Secondary stresses and distortions due to cantilever erection also became formidable considerations. After the official board of engineers had prepared a design and various designs and bids had been received from bridge works here and abroad, Mr. Johnson came forward with a design based on the new K-bracing system, and it took little investigation to confirm his judgment that this offered the most desirable solution of the problem, with decided advantages in economy of material, uniformity of deflections, and safety and ease of erection.

"To carry out this great work, the St. Lawrence Bridge Co. was formed, and Mr. Johnson became its president and general manager, continuing in this work from April, 1911, to the end of 1919. Every detail of the execution of the undertaking and its final success bear witness to his engineering ability and foresight. It was an application on a large scale of the qualities which distinguished his work throughout his career; his practical turn of mind and a wonderful insight into difficult problems of handling and assembling material, supplemented by the skill to devise methods for overcoming the difficulties ahead."

For a long time in the early period of the Dominion Bridge Co. there were but few consulting engineers in Canada, and this led to Mr. Johnson's being called upon for advice in a great many engineering matters, both without and within the field of bridgework. He came to occupy a position of peculiar authority and trust. Among those who knew him and came into professional or business contact with him, the judgment of none was more highly valued.

For many decades Mr. Johnson had been a member of the American Society of Civil Engineers and of the Canadian Society of Civil Engineers, now the Engineering Institute of Canada. In 1913 he was president of the latter society. McGill University in 1921 bestowed upon him the honorary degree of LL.D.

His private life was simple. Mr. Johnson never married, and in the absence of home ties nothing interfered with his dominant activity, that for his profession and for his company. He had few recreations, and mingled little in the social activities of his associates, but many contributions testified to his public spirit and his support of the aims of others.

A New Port for Brazil

Owing to the congestion of railway and shipping traffic at Santos, Brazil, which is the principal port of the coffee export business, the Sao Paulo Ry. Co. proposes to establish an auxiliary port at Sao Sebastiao, about 60 miles eastward. This would be served by a branch railway from Campinas. The port and harbor works are estimated to cost about $100,000,000.

Concrete Institute Holds Well Attended Meeting

(*Concluded from p. 375*)

at this convention indicated the high quality of concrete he was getting and the closenesss to the design strength.

W. S. Hindman, consulting engineer, of Columbus, Ohio, told how the inundator was successfully used in the proportioning and mixing of concrete on the University of Pittsburgh stadium. This work was reported in *Engineering News-Record*, Aug. 6, 1925, p. 222. J. G. Ahlers, of the Barney Ahlers Construction Corporation, New York City, elaborated the paper presented in *Engineering News-Record*, Oct. 22, 1925, p. 674 describing the use of his water-cement balancer in several contract jobs in New York City. F. R. MacMillan, of the Structural Materials Research Laboratory in Chicago, and Stanton Walker, late of that laboratory, described the use of the water-cement ratio method in the concreting of the new Portland Cement Association building at Chicago. This method is the one devised some years ago by Mr. MacMillan and since elaborated by him. It has for its basis the establishment of a proper water-cement ratio by actual batch mixing tests of the aggregates and observation of workability. This water-cement ratio being established, the proper amount of water for each mix is fixed and the aggregate added in such amount as will give proper workability. The paper will be abstracted in a later issue.

Descriptive articles were read on the Wilson dam by Major M. C. Tyler, of the Corps of Engineers, with an explanatory paper by John W. Hall, resident engineer of Hugh L. Cooper & Co., consulting engineer on the dam. Mr. Hall's paper explained the method of controlling the quality of concrete on the Wilson dam. Here, too, the water-cement ratio was considered, but the method of proportioning was based on the number of sacks of cement to the yard established by the condition of the aggregate. Workability was measured by the provision that workmen on the mass concrete in rubber boots should not sink more than 10 in. or less than 2 in. into the mass.

Other descriptive papers were one by A. Burton Cohen, consulting engineer of New York City, describing in considerable detail the application of concrete to highway and railway bridges which have come under his direction in the past few years, and two papers on roads by J. L. Harrison, highway engineer, United States Bureau of Public Roads, and L. W. Teller, engineer of tests of the same bureau. Mr. Harrison's paper recited some of the details of supervision which he has observed in a long trip over the country in the federal-aid road construction. Mr. Teller's paper was an elaboration of the discoveries as to road design which have already been reported considerably by A. T. Goldbeck, when he was at the head of the federal road work.

Benjamin Wilk, of the Universal Portland Cement Co., of Chicago, described a very remarkable chimney test which is now under way by his company in its new mill at Duluth. The results of this test will not be available for about a year, but it has by far the most thorough set-up for future measurements ever attempted in a chimney investigation. Observations are to be made not only on the interior temperature of the concrete in the chimney, but also upon its bending under carefully measured wind loads. Prof. H. M. Westergaard, of the University of Illinois, presented a paper on the design of rectangular floor slabs and the supporting girders, which gave figures for moment coefficients in rectangular slabs under multiple conditions of loading. The work done by the author is entirely new and the results obtained of great value to designers.

Other papers are abstracted on p. 368 of this issue.

Cement Questions

Parts of two sessions were devoted to a question box. The most important thing brought out in this discussion was the question of temperature effect on time of setting of cement. S. C. Hollister, of Philadelphia, reported that some investigations he had made showed that the cement varied by brands in its time of set between 40 to 60 deg. outside temperature and that this variation, which was quite serious in the economic determination of brand of cement in some kinds of work, could not be detected by any of the standard tests. This brought up a rather long discussion in which P. H. Bates, Bureau of Standards, Washington, showed some photo-micrographs and curves to demonstrate that the respective ingredients of portland cement all have different properties of set and that portland cement itself shows such a variable visible condition under microscope that there is no reason to expect that the product would be uniform. A. B. Cohen, consulting engineer, New York, checked Mr. Hollister by some actual tests in one of his bridges which showed that some cements act differently from others in low temperature. Ernest Ashton, Lehigh Portland Cement Co., suggested the possibility of the variation in cement being as much due to the methods of test as to the cement itself.

A further interesting point brought out was a statement by three separate members of autogenous healing of concrete which had cracked; in each case the healing was either caused or assisted by added moisture and protection.

Wason Medal Presented

The Wason Medal for the most meritorious paper presented at last year's convention was awarded to E. A. Dockstader, of Stone & Webster, Boston, Mass., for his paper entitled "Report of Tests Made to Determine the Temperatures in Reinforced-Concrete Chimney Shells."

For the ensuing year Maxwell M. Upson, of the Raymond Concrete Pile Co., New York City, was elected president. The secretary of the society is Harvey Whipple, 2970 West Grand Boulevard, Detroit, Mich.

N. Y. State Reorganization Plan Submitted to Legislature

The report of the New York State Committee on Reorganization of the Government, a committee headed by Charles E. Hughes, submitted to the State Legislature on March 1, proposes the consolidation of 180 departments, bureaus and commissions into 18 departments. Outstanding features of the report are: A recommendation that the term of the Governor of the state be extended from two to four years; an executive budget prepared by the Governor but subject to additions by the legislature, the additions to be subject to the Governor's veto; retention of the Transit Commission as part of the Department of Public Service, and important changes in the Conservation and Public Works Departments as noted in detail below.

Engineering Features

All the construction and engineering functions of the government are to be grouped in the Department of Public Works in five divisions; canals and waterways, highways, public buildings, engineering, and architecture. The head of this department is to be appointed by the Governor. Nothing is said as to his technical qualifications—which is true also of the other department heads and of nearly all the bureau heads. He, in turn, is to appoint the heads of the divisions including the head of the division of enginering who is to be the state engineer and surveyor (a position which now is an elective office) and the state architect. The state engineer is to be "a practical civil engineer." The report calls for the consolidation of the present Water Control Commission and Water Power Commission into one commission under the Department of Conservation with the conservation commissioner as chairman of the new commission and the commissioner of public works or an experienced engineering deputy, and the attorney general as the other two members of the commission. The reorganization committee also recommends that in view of the importance of the grant of water power rights these grants be made subject to the approval of the Governor and that in the case of land grants the signature of the Governor be required upon the issue of the license. The present Water Control Commission, created in 1915, consists of the state engineer, the conservation commissioner, and the attorney general with the state engineer as chairman. The Water Power Commission, created in 1921, consists of the state engineer, the attorney general, the conservation commissioner, the speaker of the Assembly, and the president pro tem of the Senate, with the conservation commissioner as chairman. The State Department of Health is left as it now stands, except that the commission must approve changes or additions to the State Sanitary Code.

No recommendation is made for the allocation of temporary commissions, civil districts, or interstate organizations such as the Albany Port District, the River Regulating Districts or the Port of New York Authority.

Indiana Society Meets with Other Societies

Large Increase in Membership and New Chapter for Indianapolis—All Sectional Meetings

With an increase in membership of 25 per cent since Jan. 1 the Indiana Engineering Society has taken on new vigor and largely increased the interest of its members. It now numbers 440 and the maximum attendance was about 100. Its forty-sixth annual meeting, Feb. 25 and 26, at Indianapolis was marked by the first indications of more than once-a-year activity in the petition signed by many of the most prominent engineers in the city for an Indianapolis Chapter under a provision provided for last year. The looked-for presentation of a plan to make the society part of a proposed national organization built on the ashes of the local chapter of the American Association of Engineers did not materialize, although the largest attended session was said to have been considerably swelled in anticipation of that eventuality.

Sectional Sessions

As to the technical program, the sectionalized idea was carried out with the four sessions devoted successively to electrical engineering, architecture and civil engineering, chemical engineering and mechanical engineering. The society has not, as might easily be inferred, made any further attempt toward the section idea. No meetings were held simultaneously. Each was well attended and the papers, usually but two to a session, were freely discussed. Three papers were of special interest to the civil engineer. One on structural engineering trends by Prof. E. L. Erickson, Purdue University; a second on zeolite water softening by James T. Vail, chemical engineer, American Doucil Co., and the third by Stanley Green, Central Indiana Power Co.

Prof. Erickson made a plea for more architectural beauty in the design of high office buildings, citing the Tribune Tower in Chicago and the awe-inspiring buildings of Europe as suggestions.

Since there are now more than thirty companies selling zeolite water-softening equipment with several of them looking forward in their experiments to so cheapening the process as to make it feasible financially for municipalities, Mr. Vail's talk was thoroughly discussed. The usual lime-soda softening process utilizes reagents that are considerably more expensive than common salt used in the zeolite or base-exchange method. By utilizing the counter-current method of bringing the water and zeolite together, now being worked out, greatly increased efficiencies are looked for. This is largely the problem of the engineer and while not mentioned, probably some such arrangement as the drifting-sand process will be used.

Mr. Green's talk, largely an exposition of the present-day superpower idea as developed in Indiana both physically and financially, was preceded by a three-reel motion picture on "Power" scientifically worked out over a long perid by the engineers of Stone & Webster. Its concrete presentation relates to the Weymouth steam plant of the Edison Illuminating Co. of Boston. Mr. Green spoke briefly of the Dresser plant of the Central Indiana Power Co., near Terre Haute, on the Wabash River directly over coal beds from which fuel is carried to the boilers by belt conveyors, being therefore a typical example of pit-mouth development. Since it is not at the geographical load center, a 132,000-volt line carries the bulk of the current to the Lenore substation near Indianapolis for principal distribution.

It is the custom of the society to have one joint session with the Scientech Club and other local technical organizations. This year that session was a dinner meeting of about 300 addressed by John Lyle Harrington, consulting engineer, Kansas City, on "The Relation of the Engineer to the Community." He stressed the engineer's inferiority complex, chided him for not getting more into public affairs and politics and deplored the lack of co-ordination among the engineers' organizations, referring especially to the lack of full co-operation of all of the founder societies with the American Engineering Council.

The newly elected officers of the society are as follows: President, E. L. Carter and vice-president, Roy Thurman. Charles Brossman, Indianapolis, continues as secretary.

Rocky Mountain Section of A.W.W.A. Formed

Following a two-day conference of 75 water-works superintendents and those interested in water from Colorado, Wyoming and New Mexico a resolution was unanimously adopted calling for the formation of the Rocky Mountain Section of the American Water Works Association.

Among the papers presented were the following: "Bacteriology of the Animas River" by Paul S. Fox, sanitary engineer, New Mexico Bureau of Public Health; "Microscopic Organisms Causing Tastes and Odors in Water" by George Turre, chemist, Denver Water Works; "Watershed Sanitation"; Dr. Sherman William, Colorado State Board of Health; "The Rocky Ford Filters" by P. E. Strouse, Water Superintendent, Rocky Ford, Colo.; "Design and Maintenance of Distribution Systems" by D. D. Gross, office engineer, Denver Water Works"; "Iodine and Goitre" by Dr. Omer R. Gillett, health officer, Colorado Springs, U. S. Public Health Service; "Bookkeeping Systems for Municipal Water Works" by P. E. Strouse.

The new filter plant at Marston Lake was visited through courtesy of the officials of the Municipal Water Works, Burton Lowther, chief engineer, and R. S. Sumner, general manager, and a dinner given by six Denver supply houses.

Officers to serve when the local section has been officially formed are as follows: P. E. Strouse, chairman; A. W. Stedman, vice-chairman; Dana E. Kepner, secretary-treasurer, sanitary engineer, Colorado State Board of Health.

Nickel Plate Merger Disapproved by Commerce Commission

The plan of the New York, Chicago and St. Louis Railway Co. for acquisition of the Chesapeake & Ohio, the Hocking Valley, the Erie and the Pere Marquette railroad companies and consolidate them into one system has been found by the Interstate Commerce Commission "not to be in the public interest except from a transportation standpoint." Therefore, it has denied the application of the Nickel Plate for authority to form a new company controlling a railway system of about 9,000 miles. The reason given is that "considerations, terms and conditions of the proposed acquisition of control found not to be just and reasonable." The commission disapproves the proposal without prejudice to the submission of a new application.

New Jersey Water Policy Report Submitted March 2

Immediately on receipt of the report of the special Water Policy Commission, March 2, the New Jersey Legislature voted to hold a special session, opening May 11, devoted entirely to the water problems of the state. The commission advised, in effect, continuation of the North Jersey District Water Supply Commission and extension of its field of operations; state purchase of undeveloped water resources through the State Board of Conservation and Development, for development as needed by regional commissions, and pooling of all the water resources of Northeastern New Jersey, public and private, for interchange during water shortages. The chairman of the commission is Willard I. Hamilton, vice-president and secretary of the Prudential Insurance Co., Newark, N. J., and its consulting engineer is Nicholas S. Hill, Jr., New York City.

Wire and Sheet Metal Gages to Be Subject of Conference

To determine whether standardization of wire and sheet metal gages shall be undertaken the American Engineering Standards Committee has called a conference of interested organizations to be held at the Engineering Societies Building in New York City on March 18. One hundred and seventy-four organizations and technical socities have been invited to participate.

Subjects to be discussed at the conference are: Shall the unification of the diverse existing systems for gaging wire and sheet metal be undertaken by a sectional committee?; should this committee be requested to make a recommendation for a systematic scheme of tolerances?; appointment of a committee to advise the A.E.S.C. in the organization of the project. A resumé of American and European practice will be given at the meeting as well as a statement of the co-operative services offered by the U. S. Division of Simplified Practice.

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 9-11, 1926.

NATIONAL CONFERENCE ON STREET AND HIGHWAY SAFETY, Washington, D. C.; Second Annual Conference, Washington, D. C., March 23-25, 1926.

NATIONAL CONFERENCE ON CITY PLANNING, New York City; Annual Meeting, St. Petersburg, Fla., March 29-31, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Spring Meeting, Kansas City, Mo., April 14-16; Summer Meeting, Seattle, Wash., June 14-16; Annual Convention, Philadelphia, Pa., October 4-9, 1926.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, N. J., May 10-13, 1926.

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Annual Meeting, Buffalo, N. Y., June 5 and 7, 1926.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., June 7-11, 1926.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, State University of Iowa, Iowa City, June 16-18, 1926.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J.; June 21-25, 1926.

INTERNATIONAL CITY MANAGER'S ASSOCIATION, Lawrence, Kansas; Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

The Massachusetts Highway Association at its annual meeting Feb. 11 elected the following officers: President, Fred B. Richardson; vice-presidents, John A. Gaffey and Pehr G. Holmes; and treasurer, Charles A. Brown.

State Sections of the American Water Works Association will meet as follows:

Illinois Section, March 24 and 25, Urbana; G. E. Habermeyer, Illinois State Water Survey, secretary.

Indiana Section, March 25 and 26, Purdue University, Lafayette; C. K. Calvert, 1902 N. New Jersey Ave., Indianapolis, secretary.

Montana Section, April 15 to 17, Butte; Herbert B. Foote, State Board of Health, Helena, Secretary.

Personal Notes

C. N. BASS has been appointed state highway commissioner of Tennessee; for the past six months he had been acting state highway commissioner and for some years assistant state highway engineer. James G. Creveling, Jr., the former state highway commissioner, resigned some months ago following a dispute between his department and the U. S. Bureau of Public Roads over the construction of the Harahan viaduct at Memphis.

CHARLES WHITING BAKER, for many years editor of *Engineering News*, has announced his connection with Baker, Simonds & Co., Inc., investment bankers, of New York and Detroit, Mich.

NORMAN R. GIBSON, for the past year executive engineer of the Niagara Falls Power Co., has been appointed chief engineer, a post that has been vacant since the death of John L. Harper two years ago. After graduation in 1904 from the University of Toronto, Mr. Gibson joined the Ontario Power Co. organization as draftsman, a year later worked with the Niagara Falls Hydraulic & Manufacturing Co. in Niagara Falls as structural design engineer, and the following year was assistant engineer on the Point du Bois development at Winnipeg and then as construction engineer on the Assiniboine River bridge at Brandon, Man. This was followed by association with Smith, Kerry & Chace, consulting engineers, Toronto, with the Electric Power Co. Ltd., and the Ontario Power Co. between 1908 and 1917. In 1918 Mr. Gibson became hydraulic engineer of the Hydraulic Power Co., now a part of the Niagara Falls Power Co. Mr. Gibson is the inventor of the Gibson method and apparatus for measuring the flow of liquids in closed conduits.

Obituary

JAMES SAQUIN, Council Bluffs, Iowa, a retired bridge builder, was found dead Feb. 19 from accidental gas asphyxiation.

JOHN O. CHISHOLM, a well-known contractor and builder, of New Orleans, La., died recently in that city after a long illness; he was a native of New Orleans and was 55 years of age.

ROBERT L. HYDE, Omaha, Neb., president of R. L. Hyde & Co., a contracting firm which has the contract for the new Burlington R.R. postal terminal in Omaha, died Feb. 21 aged 38 years. Mr. Hyde was a graduate of the college of engineering of the University of Nebraska.

FRANKLIN VAN WINKLE, assistant editor of *Power*, and a resident of Paterson, N. J., died in that city Feb. 19 in his 70th year. Mr. Van Winkle was born in Paterson, graduated at Stevens Institute of Technology, and was later professor of engineering in Texas Agricultural and Mechanical College. For twenty-seven years he was a consulting engineer on the planning, construction and testing of power plants, and he invented the Van Winkle dynamometer for measuring current. He was interested in civic work and was for twelve years a member of the Paterson Board of Health. Among buildings which he designed was the Paterson city hospital, the design receiving a medal at the Chicago world's exposition.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Construction Equipment—Its Purchase and Sale

Suggestions to Manufacturers and Contractors for Their Mutual Efficiency and Profit

By J. F. GALLAGHER

Executive Secretary, Illinois Association of Highway and Municipal Contractors, Chicago

The following address (slightly condensed) was delivered before the seventh annual meeting at Milwaukee, Wis., Jan. 6, of the Associated Equipment Distributors.

THERE seems to be a great tendency on the part of certain contractors to over-equip themselves, particularly when undertaking a new type of work. I would therefore suggest that the contractor who is contemplating the purchase of additional equipment ask himself these questions:

1. Do I really need this equipment?
2. Can't I get along without it?
3. Can I use it to advantage?
4. Will it justify the investment of the capital involved?

Some contractors apparently think that the more equipment they have on the job, the more efficiently will their work progress and that they will have a larger profit in the job. They consequently invest vast sums in unnecessary equipment and eventually find themselves equipment poor.

A Contractor's Suggestions to Contractors

1. *Do not over-equip.*
2. *Investigate carefully the design and quality of competitive products.*
3. *Make thorough inquiry into performance of machines on work similar to your own.*
4. *Ascertain that machine is a standard design and not a novelty.*
5. *Determine kind of service competitive manufacturers render.*
6. *Do not purchase equipment on price alone.*

Design and Quality.—Having satisfied himself as to the advisability and necessity for the purchase, the next thing to be considered is the design and quality of the product. He should carefully investigate the quality of the materials and the workmanship entering into the fabrication of the machine. He should study the manufacturer's specifications and inform himself fully in this respect. A visit to the factory is advisable if this is convenient.

Of course, he will make a thorough inquiry into the performance of the machine on work similar to that for which he wants to use it. It is quite generally agreed that a certain type of equipment may give excellent service on one class of work and be far from efficient on another.

He would do well to ascertain whether the equipment is of standard design and not a novelty made up along purely theoretical lines.

Service from Manufacturers.—Next in importance is the service the contractor may expect from the manufacturer or his authorized agent. He must remember that no machine is foolproof and that even those built according to the most rigid specifications and inspection are liable to develop defects which are undetectable during the process of manufacture. He should make certain that the firm from whom he purchases can furnish necessary replacements without delay, as the loss of an hour's working time will cost him many times the value of the broken part which caused the delay. Therefore, the speed with which replacements can be made is a most valuable consideration. The distributor should be in position to furnish intelligent and efficient service men quickly and without quibbling if the service feature is to be complete.

For his own protection the contractor should take into consideration the general reputation of both the manufacturer and distributor. They should have a high standing in the industry for honesty and fair dealing.

Price and Value.—Having satisfied himself as to these features, the all-important matter of price can be given intelligent consideration. Naturally enough, the tendency will be to place the order with the manufacturer who offers the greatest value from the standpoint of quality and service at the lowest price. There will, of course, be a strong inclination to buy at the lowest figure, but too much cannot be said to warn against the purchase of equipment which is sold on the basis of price only. A man seldom gets more than he pays for, though he may congratulate himself on his ability to buy at a close figure. There can be no question, however, but that there is often too great a disparity between the selling prices of commodities of the same or slightly different quality. Only sound business judgment will enable the contractor to evaluate the various machines and gauge their true value. It is to be expected that all but the successful salesman will question the judgment, or even the sanity of the buyer, but as he is the man who pays the bill, it is his undeniable privilege to buy what he pleases and from whom he pleases.

Suggestions to Manufacturers.—Here are a few suggestions from the standpoint of the contractor to the manufacturer and distributor:

Radical changes in models, which are not made as a result of thorough practical tests, should be discouraged. In the final analysis, a great portion of the loss resulting from changes in design due to unsatisfactory service or obsolescence, is borne by the contractor. Changes of this kind are not in keeping with the trend toward standardization and the elimination of unnecessary sizes and capacities.

New models should be subjected to thorough practical tests by the manufacturer before being offered for sale to the contractor. Otherwise the construction job is made the experimental laboratory for the manufacturer.

It would greatly facilitate the contractor's field operations if the manufacturer would furnish him with a complete list of parts, conveniently arranged and identified. To the manufacturer the sale of the parts themselves is but a small matter, but to the contractor the prompt receipt of replacements is of most vital importance in keeping down overhead costs. In fact it is so very important as to warrant the suggestion that every order for parts be given precedence over routine business and be despatched to its destination with the greatest possible speed.

A Contractor's Suggestions to Manufacturers

1. *Make radical changes in models only as a result of practical tests i.e. do not make the contractor's job your field laboratory.*
2. *Furnish complete part lists.*
3. *Give spare part orders preference over routine business.*
4. *Give practical and specific rather than general information in trade literature.*
5. *Use greatest discretion in selection of salesmen and distributors.*
6. *Do not finance poor contractors by long term credit sales.*
7. *Do not meddle in contract lettings.*

Make Trade Literature Specific.—It would be difficult to estimate the enormous sums spent annually by manufacturers in the preparation and distribution of advertising literature, catalogs, etc. It would be my suggestion that, whenever possible, such pamphlets should contain the greatest amount of information concerning the specifications, the weights, sizes, and other pertinent data regarding the equipment described. In my opinion, much literature of this kind is too general in its description of the commodity. Contractors, as a rule, are extremely poor correspondents, and will not write to the manufacturer for detailed information in which they would be interested if it was contained in the advertising.

The manufacturer should use the greatest discretion in the selection of his salesmen and distributors. There are some so-called "high-power" salesmen who are doing more to injure their employers' standing with the contractors than they are doing good.

The manufacturer will better serve his own ends if he will thoroughly investigate the qualifications and reputation of his distributors before granting them agency privileges. In the long run he will be far better off if he will handle the distribution of his product himself rather than entrust it to a distributor of questionable standing and poor reputation for service to the trade.

Irregular Practices.—I wish to call attention to the rapidly growing resentment of the nation's contractors to the tendency of equipment manufacturers and distributors to engage, indirectly, in the contracting business. I h ve in mind the practice by which inadequately financed individuals and firms are assisted in the purchase of equipment by seemingly unlimited terms of payment. The manufacturer or distributor who becomes a party to such a transaction, in effect becomes a partner of the financially weak contractor. By so doing he encourages irresponsibility to the detriment of the better c ntractors. The responsible contractor, if he has not the necessary cash on hand, as is frequently the case during the construction season, can procure credit through his banking connections which will enable him to purchase what equipment he actually needs.

It is usually the man who aspires to a meteoric rise as a contractor, but who has neither the equipment, capital nor often the ability, who seeks extremely long terms on his equipment purchases, and it is he who usually underbids the established contractor by such a wide margin that he can scarcely break even on the job, thereby preventing the responsible man from getting work at a legitimate profit. He must make some pretense of meeting his obligations and in desperation will take work far below his responsible competitors. In this respect the equipment industry is contributing to the instability of the contracting business.

There have been called to my attention, instances where equipment salesmen have gone so far in their pursuit of business as to encourage material dealers, hauling contractors and others, to become engaged in street and highway construction. Needless to say, the equipment distributor who goes to such ends to effect a sale, incurs the ill will of the legitimate contractor as well as in the end the victim he misled.

An increase in the number of contractors will not necessarily mean an increased volume of construction, and consequently, in the end, will not mean an increased sale of construction equipment. Responsible contractors must have equipment to carry on their work, but if they are to be deprived of that work by the irresponsible fly-by-night contractors, encouraged and financed by manufacturers or dealers, it is logical that they will not purchase equipment which they would otherwise buy. What, then, does the equipment industry gain as a result of these tactics?

Finally, I would suggest that there be included in the distributors' code of ethics, a policy of neutrality on the part of their men in the field. That is to say, that they refrain from meddling in the letting of contracts by urging the competition of contractors who are unqualified or unfamiliar with the work, or who for any other reason would not bid were it not for the urging of the meddlesome salesman. Sooner or later this practice will act as a boomerang on the man who engages in it. It will result in the loss of good will and friendship.

Annual Meeting of Reinforcing Steel Institute

The second annual meeting of the Concrete Reinforcing Steel Institute will be held March 10 and 11 at the Hotel Traymore, Atlantic City. Besides the president's annual report and the business transactions of the institute there will be two special addresses by W. Chattin Wetherill, director Metals Utilization, U. S. Department of Commerce, and Thomas S. Holden of the F. W. Dodge Corp., New York City.

A feature of the second day's program will be a symposium on unusual reinforced concrete construction during 1925.

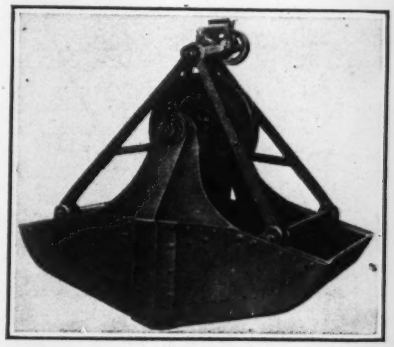
Motion Pictures on Asphalt Paving Loaned

Any responsible organization, club or educational institution desiring to secure the loan of motion pictures showing modern methods of constructing either sheet asphalt or asphalt macadam pavement should write to the asphalt sales department of the Texas Co., New York City. The letter should mention several dates on which the use of either or both of the films is desired. The asphalt macadam picture can be shown in 15 to 20 minutes, while the one on sheet asphalt requires 30 to 40 minutes.

Equipment and Materials

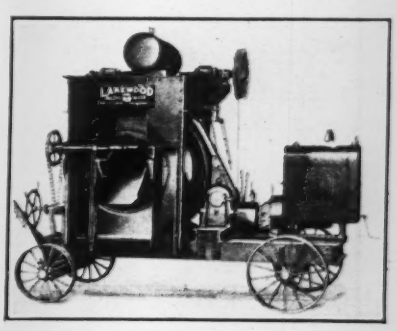
Two-Purpose Bucket for Snow and Regular Handling Work

By utilizing the same operating mechanism and connecting rods and providing two shells, one of large capacity for snow handling, and the other of smaller capacity as used in the company's ore bowl clamshell buckets, the Hayward Company, New York City, has provided a new two-purpose bucket. It will be noted in the illustration that the shells of the snow bucket extend beyond the connecting rod brackets. This feature gives 1½ cu.yd. capacity for the same operating mechanism as used on the 1 cu.yd. standard Hayward clamshell bucket. It is claimed that the conversion from one type of bucket to another may be accomplished by ordinary mechanics in a comparatively short time. It is also claimed that these buckets have ample closing power and the weight so distributed that they will dig in and not slide over the icy slopes of frozen snow piles.



Worm Speed Reduction Used on Building Mixers

The principal driving mechanism on the 7-S and 14-S building mixers f the Lakewood Engineering Co. Cleveland, Ohio, is now completely inclosed in an airtight housing, is mounted on ball bearings and runs in oil. This is made possible by the use of a worm speed reduction instead of the usual gears and shafts or chains and sprockets to reduce the engine speed to the speed of the drum. A freedom from noise and vibration, new to concrete mixers, is said to be possible.



The mechanism is a heat-treated steel worm direct connected by a universal coupling to the engine shaft. It drives a bronze worm gear which is mounted on the drum pinion shaft. Through this one unit the speed of the engine crankshaft is reduced to the proper speed for the drum. The drum gear and its pinion are covered with a steel guard as are also the drive shafts and the power loader mechanism. The latter consisting of a flexible coupling, hoist drum, brake, clutch and knockout, is mounted as a unit in a frame and is thus easily removed or attached.

The use of the worm reduction, it is claimed, gives several advantages. The radiator is faced directly away from the drum. The crank of the motor is hung over one end of the frame, while both sides of the motor are always accessible. Changing from gas to electric power is simplified, since the only change is the use of a different universal coupling bored to fit the shaft of the motor. As the power take-off is based on 1,200 r.p.m. for either gas or electric power, no change in speed reduction is necessary.

Other new developments include self-aligning bronze bearings throughout, Alemite lubrication, and a pivoted power loader having a discharge angle of 50 deg.

Engineering News-Record Statistics of the Construction Industry

Mar. 4, 1926 — *in the United States* — Vol. 96, No. 9

Engineering News-Record CONSTRUCTION COST Index Number (1913 = 100)

MONTHLY

January, 1925, to Date

March, 1926	**207.65**
February, 1926	206.55
March, 1925	210.20
Peak, June, 1920	273.80
1913	100.00

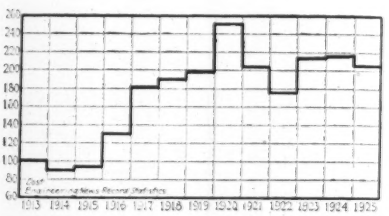
1925

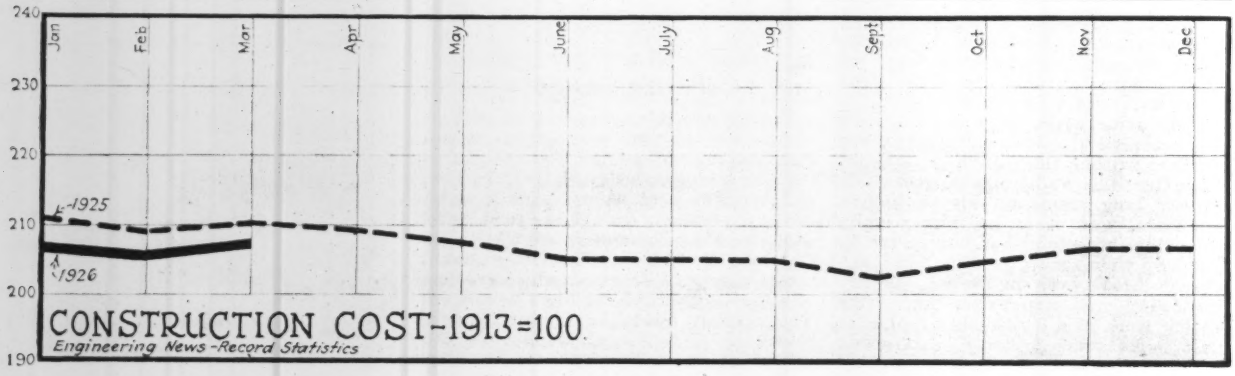
Jan.	210.40	May	207.20	Sept.	202.10
Feb.	209.70	June	204.60	Oct.	205.35
March	210.20	July	204.60	Nov.	205.95
April	209.55	August	204.60	Dec.	205.95
January, 1926					207.15

ENGINEERING NEWS-RECORD'S Construction Cost Index Number is 0.5 per cent above February, 1926, owing to higher cost of lumber and labor. The average rate for common laborers is 54¼c. per hr. for the entire country as against 54c. one month ago and 54¼c. one year ago. Thus general construction cost is 1.2 per cent below a year ago and 24 per cent under the peak; it is 107 per cent above the 1913 level.

YEARLY

1913 to 1925





Engineering News-Record CONSTRUCTION VOLUME Index Number (1913 = 100)

MONTHLY

January, 1924, to February, 1926

February, 1926	**187**
January, 1926	198
February, 1925	145
Peak, August, 1925	266
1913	100

1924

January	125	May	194	September	159
February	144	June	149	October	164
March	161	July	161	November	128
April	159	August	162	December	145

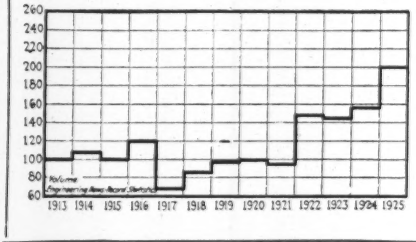
1925

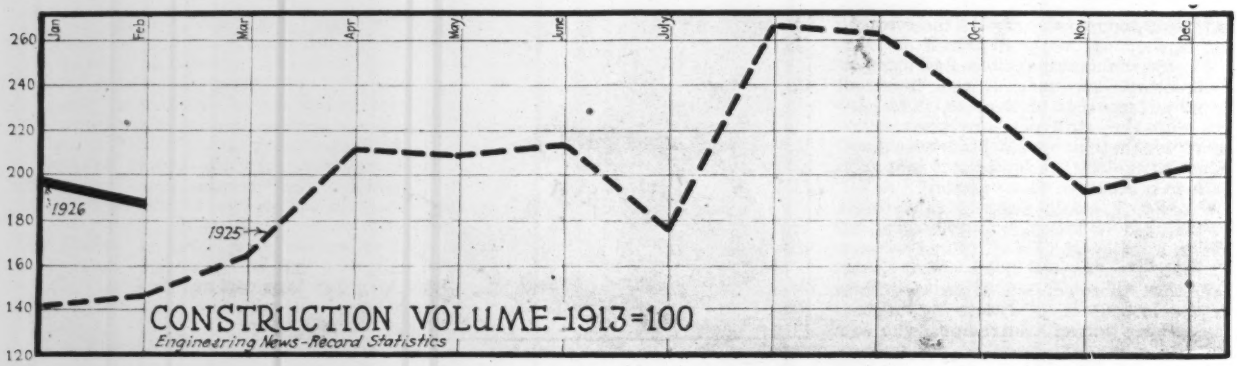
January	141	May	209	September	262
February	145	June	214	October	233
March	161	July	178	November	194
April	211	August	266	December	206

ENGINEERING NEWS-RECORD'S Construction Volume Index Number is 187 for the month of February, and 201 for the whole of 1925, as against 100 for 1913. This means that the actual volume of construction in 1925 (not the mere money-value of the contracts let that year) is 101 per cent above the volume of construction for 1913. The monthly volume number, 187 for February, 1926 contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

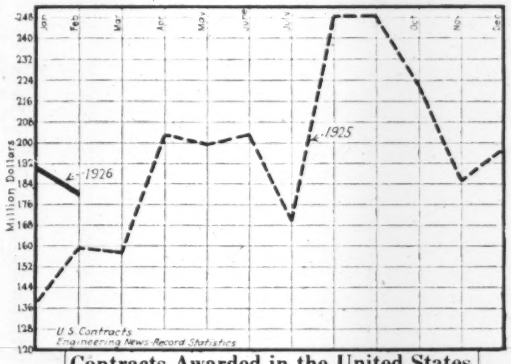
YEARLY

1913 to 1925

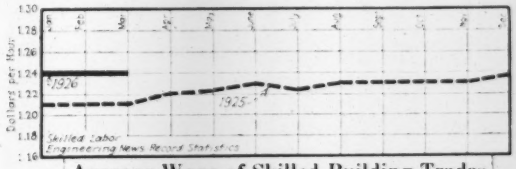




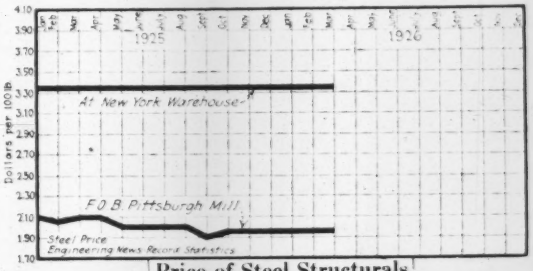
Monthly Statistics of the Construction Industry



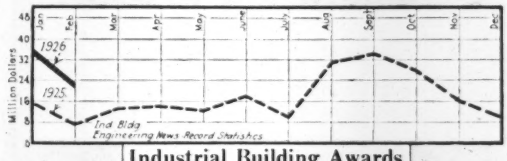
Contracts Awarded in the United States
Reported in E. N.-R.



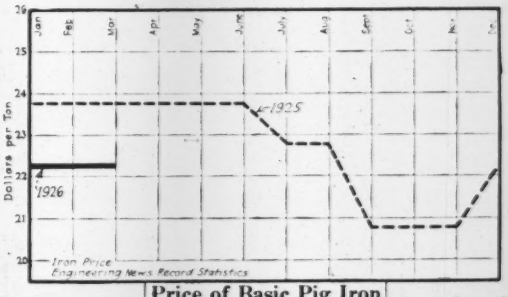
Average Wage of Skilled Building Trades
Bricklayers, Carpenters and Steel Erectors



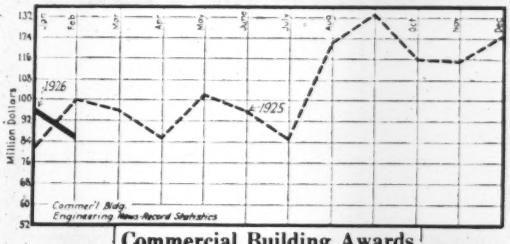
Price of Steel Structurals
Shapes 3-In.; Plates ¼-In.



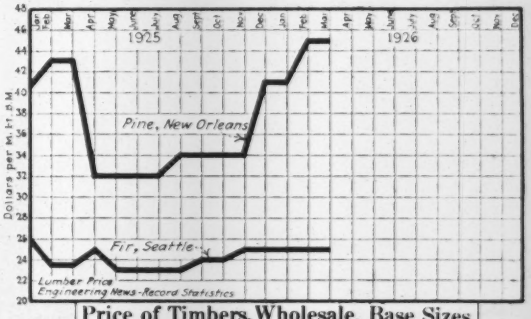
Industrial Building Awards
$40,000 and Over



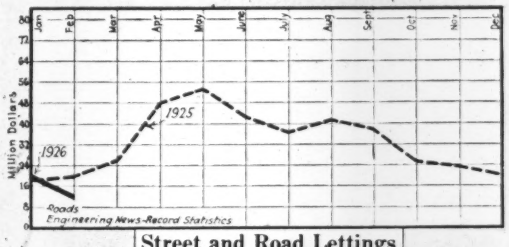
Price of Basic Pig Iron
F.o.b. Pittsburgh



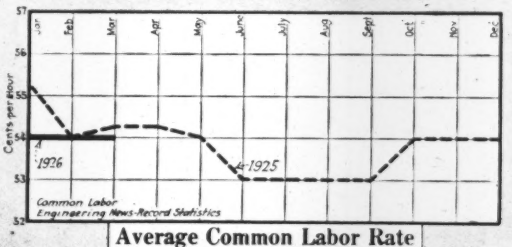
Commercial Building Awards
$150,000 and Over



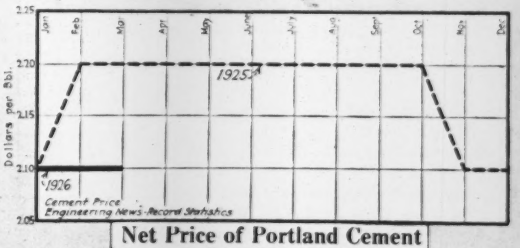
Price of Timbers, Wholesale, Base Sizes
Car Lots to Contractors



Street and Road Lettings
$25,000 and Over

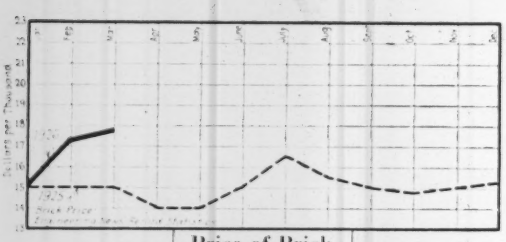


Average Common Labor Rate
Pick and Shovel Men

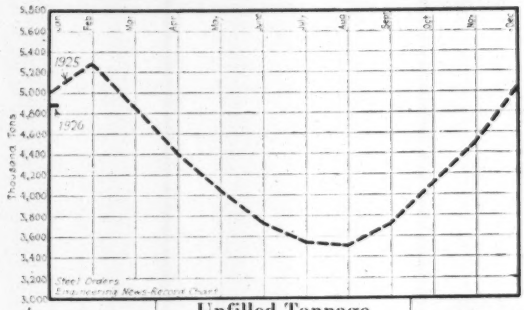


Net Price of Portland Cement
Car Lots, F.o.b. Chicago

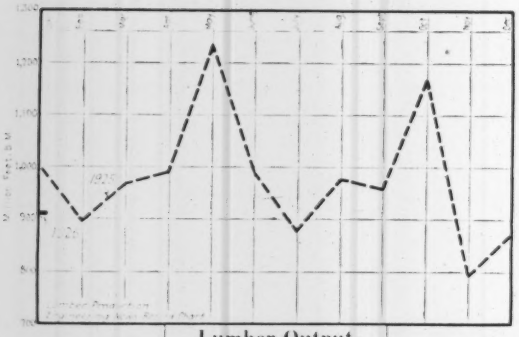
Monthly Statistics of the Construction Industry



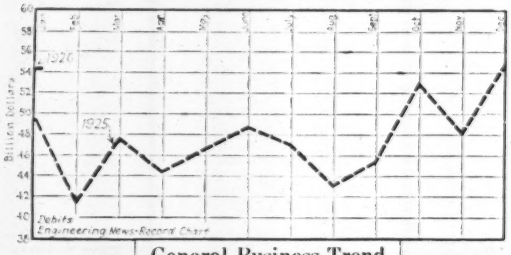
Price of Brick
At Dock, New York



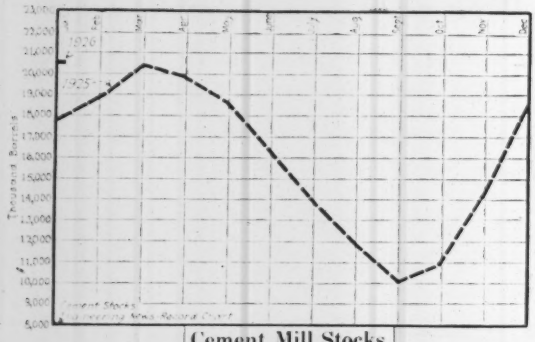
Unfilled Tonnage
On Books of U. S. Steel Corp.



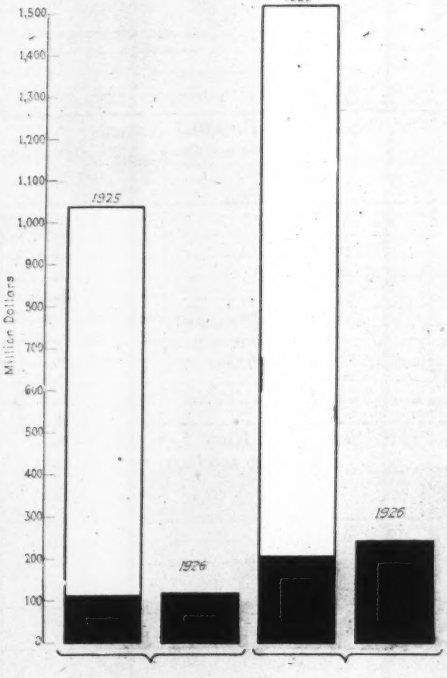
Lumber Output
Nat. Lumber Mfrs. Assn.



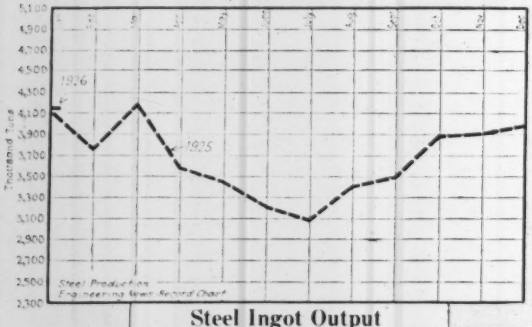
General Business Trend
Bank Debits—Federal Reserve



Cement Mill Stocks
Bureau of Mines



Public—Contracts—Private
Jan. 1 to date
Reported by E. N. R.



Steel Ingot Output
Gross Tons; Am. Iron and Steel Inst.

Volume of February Construction Heaviest for That Month on Record

Gains Mostly in New England and the South

MONEY value of contracts awarded during February and actual volume of materials used in construction, were heavier than for the corresponding month in any year since 1913, according to *Engineering News-Record* statistics.

Figures in the accompanying table represent all water-works and excavating jobs of $15,000 and over; other public work, $25,000 and up; industrial buildings valued at $40,000 or more; commercial and other buildings at $150,000 and above.

February lettings were 5 per cent below those of the month preceding and 12½ per cent greater than for the corresponding period in 1925.

Despite the drop in money value of awards, there were substantial gains in water-works, private bridge and commercial building projects, public excavating jobs, and Federal Government work.

New England showed an increase during February mostly in the states of Maine, Massachusetts and Rhode Island.

The South registered its usual gain, led by Florida, the Carolinas, West Virginia and Kentucky.

Despite freezing weather, construction activity was greater in New York, New Jersey and Pennsylvania. The decrease in Maryland appeared all the more marked because of the $20,000,000 Conowingo power project, which was included in the January total.

While the total for the entire West was considerably below the January level, there were marked gains in Illinois, Minnesota, Iowa, Arkansas, South Dakota, Nebraska, Oklahoma, Arizona, and Nevada.

Slight declines in contract letting during February, were noted in the following states: Maryland, Georgia, Tennessee, Ohio, Michigan, North Dakota, Kansas, Texas, Idaho, Washington and Oregon. Construction was slow, comparing February with the month preceding, in Vermont, Delaware, Virginia, Montana, Wyoming, Colorado, New Mexico and Utah.

Value of Contracts Let in the United States and Canada, February, 1926

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Date U. S.	Canada
Water-works	$750,000	$188,000	$96,000	$1,239,000	$3,418,000	$148,000	$5,839,000	$9,186,000	....
Sewers	....	637,000	111,000	3,379,000	153,000	75,000	4,355,000	12,843,000	$60,000
Bridges	158,000	339,000	1,267,000	836,000	1,097,000	350,000	4,047,000	9,516,000	100,000
Excavation, drainage, etc	....	144,000	25,000	1,581,000	240,000	111,000	2,101,000	3,861,000	....
Streets and roads	710,000	963,000	2,933,000	1,651,000	3,136,000	2,796,000	12,189,000	32,178,000	....
Industrial building	595,000	10,950,000	5,305,000	2,984,000	1,972,000	347,000	22,153,000	57,472,000	....
Commercial building	6,515,000	39,420,000	8,393,000	25,068,000	5,989,000	12,480,000	97,865,000	194,425,000	2,592,000
Federal Government	....	1,305,000	2,356,000	20,000	2,034,000	1,063,000	6,778,000	9,224,000	....
Unclassified	129,000	9,383,000	11,967,000	700,000	2,214,000	312,000	24,705,000	41,974,000	2,000,000
February, 1926	$8,857,000	$63,329,000	$32,453,000	$37,458,000	$20,253,000	$17,682,000	$180,032,000	$370,679,000	$4,752,000
January, 1926	7,972,000	71,085,000	24,855,000	40,901,000	25,821,000	20,013,000	190,647,000	....	7,384,000
February, 1925	11,568,000	70,238,000	15,693,000	18,247,000	20,331,000	18,986,000	155,063,000	....	1,658,000
Jan. 1 to date, 1926	**16,829,000**	**134,414,000**	**57,308,000**	**78,359,000**	**46,074,000**	**37,695,000**	**370,679,000**	....	**12,136,000**
Jan. 1 to date, 1925	24,516,000	122,101,000	31,494,000	44,169,000	53,729,000	50,153,000	326,162,000	....	6,519,000

The E. N.-R. Construction Cost Index Is 207.65—108.50 Or 52 Per Cent of It Goes to Labor

The Employment Situation In General and in the Construction Industry

General

THE belief, held by not a few, that the peak of the building boom has been or is about to be reached, is certainly not supported by recent reports of building permits issued and projected construction other than buildings, definitely reported as proposed.

Building permits according to S. W. Straus & Co. are 9 per cent ahead of a year ago, while proposed projects other than buildings, as reported in the Construction News section of *Engineering News-Record*, are 24 per cent greater in money value than at this time last year.

Trade and industry, generally, appear to be striving to keep up the pace maintained during the past few years.

Building materials represent about 26 per cent and automobiles and trucks about 2 per cent of the present heavy volume of freight loadings. The Class 1 roads of the country have hauled over 900,000 carloads per week since the beginning of the current year; this has never occurred in the corresponding period of any preceding year. Nearly three-quarters of this represents the volume of business other than construction and automotive. A large percentage of the recent gain in both production and factory payrolls had to do with supplying other than these two industries.

The recent softening of money rates, with the exception of call loans, increases the probability of a continuation of the present high rate of construction activity. While loans remain comparatively easy to negotiate, buildings will coninue to go up with the hope of a proportional expansion in future business.

That these funds are gravitating away from state, county and municipal improvements is indicated by the report of the *Commercial and Financial Chronicle* on public bond sales for January. Disposals during the first month of 1926 on this class of engineering operations were in smaller volume than for the corresponding period in any year since 1919.

While the peak of construction volume may actually have been reached last August, contracts awarded for the entire country, Jan. 1 to date, are substantially ahead of the corresponding period in 1925, according to *E. N.-R.* statistics.

The cost of living and prices of building materials are at exactly the same level, compared with a 1913 base. Common laborers are plentiful and receive no more money than they did a year ago on the average. The great danger of prohibitive cost of construction lies, therefore, in the direction of skilled building trades wages. A continuation of existing rates would probably do much toward prolonging the boom.

Construction

Thirty-seven building trades of New York City recently submitted demands for higher wages to take effect Mar. 1, 1926, at which time agreements expired. Thus far, the only trades to take definite action have been the stone masons and the bricklayers. Both demand an increase of 50c. per hr. over the former base rate of $1.50.

Chicago building crafts demand modification of present agreement prohibiting sympathetic strikes on jobs manned by non-union workers. Steamfitters are agitating for an increase of 39c. per hr. above the present rate.

With less than the seasonal volume of work on hand, Philadelphia is having trouble with certain of the building crafts. Carpenters, electricians, stone masons, and hoisting engineers demand

Current Building Trades Wage Rates Per Hour

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.50@1.75	1.00@1.10	1.00@1.12½	1.00	$0.65	1.12½	.40
Birmingham	1.00@1.50	.35@.87½	.75@1.25	.50@.75	.....	.75@1.75	.20@.40
Boston	1.25	1.10	1.10@1.30	.75	1.10	1.10@1.25	.50@.75
Cincinnati	1.50	1.25	1.25	.92½	1.25	1.25	40@55
Chicago	1.50	1.37½	1.37½	.87½	1.37½	1.37½	.82½@.87½
Cleveland	1.50	1.25	1.30	.87½	1.00	1.50	.87½
Dallas	1.62½	1.12½	1.00	.40@.75	.87½	1.00	.30@.50
Denver	1.62½	1.12½	1.12½@1.18¾	.81¼@.87½	1.00	1.15⅝	.35@.55
Detroit	1.50	.70@1.00	.85@1.00	.90	.85@1.00	1.12½	.50@.60
Kansas City	1.37½	1.12½	1.12½@1.25	.90	1.12½	1.25	.35@.75
Los Angeles	1.25	1.00	1.00	.87½	+.81¼	1.00	.50
Minneapolis	1.12½@1.25	.87½@90	.87½	.71½	.....	.87½	.45@.55
Montreal	+1.00	+.85	.56¾	+.30@.35	.50	.80	.20@.30
New Orleans	1.25	.90	1.00	.65	.85	1.25	.35@.40
New York	1.50	1.31¼	1.50	1.00	1.00@1.12½	1.50	.62½@.75
Philadelphia	1.62½	1.12½	1.02¼	1.12½	1.00	1.12½@1.25	.45@.50
Pittsburgh	1.62½	1.37½	1.37½@1.43¾	1.09⅜	....	1.43¾	.75
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.50	1.50	.45@.1.00
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.37½	1.12½	1.00@1.12½	1.00	1.00@1.12½	1.12½	.50@.62½

wage-advances for the 1926 season. Cut-stone workers are resisting open shop conditions and painters threaten to strike.

San Francisco building crafts are preparing to make a general movement Apr. 1, against present open-shop conditions in the construction industry. There have been no strikes under the open-shop plan during the past four years. Los Angeles marble and tile workers threaten strike. Pittsburgh building trades demand an increase in wages; decision will probably be rendered before Mar. 15.

Monthly Prices of Construction Materials

Ups and Downs of the Market

PRICES of most of the basic construction materials show seasonal lack of fluctuation. Brick is up 60c. in New York and Dallas and $1 per M. in Philadelphia, compared with a month ago; foreign makers are preparing to enter the Spring brick market. Lumber and steel plates are above the February levels. Cast-iron pipe and wire nails tend upward in the West. Pig iron is lower than at this time last year. Compared with last month prices of such materials as track bolts, iron and steel scrap, paint materials, steel sheets, and structural rivets, are lower.

Pig Iron — A base price of $22 to $23 for second quarter iron has been fixed in Birmingham. Contract buying for delivery in April, May and June is in evidence. There seem to be some disappointments on both sides of the base price thus fixed by contracts. Furnace interests had hoped to see the base price go higher than $23, and the consumers had hoped to see iron under this figure. While there has been no great booking of contracts for second quarter iron, there is active inquiry and soon after the first of March the buying movement is expected to be in full swing. Furnaces are still unable to add anything to the reserve iron now stored on their yards. There is now less than 42,000 tons on hand. A normal is around 100,000 tons. January started out with 26 furnaces in operation and closed with 25 going, the Tennessee Company blowing out a stack at Ensley.

Railway Supplies—Demand for railway equipment, anticipated a month ago, has been developing slowly. Rails, ties, spikes, etc., remain firm and unchanged, while the price of track bolts tends downward.

Pipe—Steel and clay pipe show no tendency toward price fluctuation although demand for the former is increasing. Cast-iron pipe is firmer in the West.

Road and Paving Materials—With road building at a seasonal low ebb, the only price changes in this group reported in seventeen cities, were a slight decline in asphalt at Kansas City, Mo. and a drop in wood paving blocks in Minneapolis.

Sand, Gravel and Crushed Stone—The price situation in aggregates is dormant; changes in present quotations are anticipated in another month. San Francisco reports substantial declines while the price of Joplin chats advanced sharply in the Kansas City district.

Lime and Cement — Advances balance declines in the former, while the latter retains its customary price stability.

Brick and Hollow Tile — The price of brick is tending higher throughout the country, partly because of freezing weather in the presence of continued demand and partly owing to lack of pulverized anthracite coal used in the process. Prices are up 60c. per M. in New York and Dallas and $1 in Philadelphia, compared with the February levels. Hollow tile remains firm and unchanged throughout the country.

Structural Steel—Quotations appear a trifle stronger than a month ago, particularly on plates. Demand for structurals is developing steadily with current mill prices on the principal hot-rolled products as follows: Reinforcing bars, $2; shapes, $1.90@$2; plates, $1.80 per 100 lb., Pittsburgh. This represents an advance of 5c. per 100 lb. in plates during the month.

Lumber—Price advances are in excess of declines with most of the fluctuation in long-leaf yellow pine. Buying is especially active in pine car decking and other railroad material, finish, dimension, and No. 2 common flooring. Florida demand has slackened considerably during the month.

Scrap—With the exception of railroad malleable and cast borings, scrap prices tend downward in New York and Chicago; no tending to change is apparent in the Birmingham district.

Explosives—Little change has been noted since the general decline of a month ago in special 40 and 60 per cent gelatin dynamite.

Paint Materials—Linseed oil dropped 1½c. per gal. in New York and 2c. in Chicago during the month. Prices were above a dollar per gallon in both places at this time last year. Red and white lead are about 1c. per lb. under the March 1925 level.

Next Week—

"High Spots in the New Revenue Law"

By Robert Murray Haig

School of Business, Columbia University

E. N.-R. Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton f.o.b.:

CINCINNATI	Mar. 4	One Year Ago
No. 2 Southern (silicon 2.25@2.75)	$24.05	$26.05
Northern Basic	24.27	23.77
Southern Ohio No. 2 (silicon 1.75@2.25)	24.27	23.77
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	28.37	32.25
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	22.00@23.00	22.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	24.16	24.76
Virginia No. 2 (silicon 2.25@2.75)	29.17	30.17
Basic	23.16	24.76
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	23.00	22.00
No. 2 Foundry Southern (silicon 2.25@2.75)	26.55	28.01
PITTSBURGH, including freight charge ($1.76) from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	22.27	23.77
Basic	22.27	23.77
Bessemer	22.27	23.77

SCRAP—The prices following are f.o.b. per ton paid by dealers:

	New York	Chicago	Birmingham
No. 1 railroad wrought	*$14.25*	*$13.25@$13.75*	$13.00@$13.50
Stove plate	*10.75*	*14.50@15.00*	14.00@14.50
No. 1 machinery cast	*10.00*	*16.50@17.00*	17.00@17.50
Machine shop turnings		8.00@8.50	8.00@8.50
Cast borings	12.25	12.00@**12.50**	8.00@8.50
Railroad malleable	17.00	**15.25@15.75**	17.00@18.00
Re-rolling rails	13.25	14.75@15.25	16.50@17.00
Re-laying rails	23.50		21.00@22.00
Heavy melting steel	*12.00*	*12.25@12.75*	

Railway Supplies

STEEL RAILS—The following quotations are per ton f.o.b. for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	Mar. 4	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	
Standard openhearth rails	43.00	43.00	43.00	43.00	$51.00
Light rails, 8 to 10 lb.	36@38	33@36	34@36	1.80@1.90	2.05*
Light rails, 12 to 14 lb.	36.00	33@36	34@36	1.80@1.90	1.88*
Light rails, 25 to 45 lb.	36.00	36.00	34@36	1.80@1.90	1.84*
Re-rolled rails	30@34	27@32	34@36	34@36	17.58@18.00

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, white oak, plain	$1.35	$1.65
Chicago, empty cell creosoted	1.70	2.00
Chicago, zinc treated	1.50	1.80
San Francisco, green Douglas fir	.84	1.14
San Francisco, empty cell creosoted, Douglas fir	1.70	2.25
St. Louis, white oak, plain	1.15	1.45
St. Louis, zinc treated	1.55	1.85
St. Louis, red oak, plain	1.05	1.35
St. Louis, sap pine-cypress	.90	1.20
Birmingham, white oak	1.25	1.45

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Mar. 4	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.80	$2.90	$3.55	$3.65	$4.35	$3.00
Track bolts	3.90@*4.15*	3.90@4.25	4.55	*4.00*	*5.35*	3.90
Standard section angle bars	2.75	2.75	3.40	3.25@3.75	4.00	4.15

Pipe

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13
LAP WELD					
2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			
LAP WELD, EXTRA STRONG, PLAIN ENDS					
2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

STEEL PIPE—From warehouses at the places named the following discounts hold for welded steel pipe:

	Black			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	53%	54%	62%	49%
2½ to 6 in. lap welded	48%	51%	55%	46%
	Galvanized			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	39%	41%	50½%	36%
2½ to 6 in. lap welded	35%	38%	43½%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36 −5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

			New York	
	Birmingham	Burlington, N. J.	Mar. 4	One Year Ago
4 in.	$45.00@46.00	$52.00@54.00	$54.60@56.60	$58.60@59.60
6 in. and over	41.00@42.00	48.00@50.00	50.60@52.60▲	54.60@55.60
	Pittsburgh	Chicago	St. Louis	San Francisco
4 in.	$53.60@54.60	$53.20@54.20	*$51.50*	$55.00
6 in. and over	49.60@50.60	49.20@50.20	47.60	51.00

Gas pipe and Class "A," $4 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

	New York					
Size, In.	Mar. 4	One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$48.00	$48.00	$40.00	$45.00		$73.00
4	60.00	50.00	40.00	56.00	$76.50	110.00
5				80.00	97.75	118.00
6	90.00	92.00	70.00	100.00	127.50	150.00
8	160.00	160.00	170.00	165.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3		$0.108	$0.10		$0.09	$0.12	
4		.108	.10	$0.10	.09	.15	$0.15
5		.1485	.135		.13½	.18	.18
6	$0.21	.1485	.135	.14	.13½	.21	.21
8	.35	.243	.21	.225	.21	.30	.325
10	.52	.2835	.315	.315	.31½	.42	.476
12	.66	.3645	.45	.405†	.40½	.56	.612
15	1.14†	.486	.54	.675†	.54	.92	1.02
18	1.65†	.675	.75	.945†	.75	1.32	1.53
20	1.98†	.81	.90	1.26†	.90		
22	2.65†	1.08	1.20		1.20		1.564
24	2.97†	1.215	1.35	1.62†	1.35	2.16	2.04
27	4.65†	2.405	2.665	2.45†	2.75	3.00	3.34
30	5.16†	2.664	2.952	3.00†	3.75	3.60	4.06
33	6.98†	3.60	3.96	3.55†	4.50		4.99
36	8.00†	4.10	4.51	3.95†	5.00		5.42

	3	5	8	12	24	36
Boston	$0.13	$0.20	$0.30	$0.60	$2.00†	$5.50†
Minneapolis			.225	.405	1.35	4.75
Denver	.135*	.18*	.27	.47	1.70	
Seattle	.14		.35	.72†	2.60†	
Los Angeles	.1625	.195	.275	.495	1.65	
New Orleans	.115*	.117*	.295	.4725	1.575	
Cincinnati	.105	.1575	.245	.4725	1.575	4.715
Atlanta	.10*	.15*	.25	.425	1.625	
Montreal	.68‡	.45†	.70	1.35	4.50†	
Detroit	.11	.1665	.259	.4995	2.25†	7.175†
Baltimore	.111	.166	.259	.499	1.665	4.92
Kansas City, Mo.	.15*	.21*	.29	.52	1.90†	3.80†
Philadelphia	.11	.17	.26	.50	1.67	3.80

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

Road and Paving Materials

ROAD OILS—Following are prices per gallon in tank cars, 8,000 gal. minimum f.o.b. place named:

	Mar. 4	One Year Ago
New York, 45% asphalt (at terminal)	$0.065 @ $0.07	$0.07
New York, 65% asphalt (at terminal)	.0675@.0725	.0725
New York, binder (at terminal)	.07 @ .075	.075
New York, flux (at terminal)	.07 @ .075	.075
New York, liquid asphalt (at terminal)	.07 @ .075	.075
St. Louis, 40@50% asphalt	.057	.0592
St. Louis, 50@60% asphalt	.0575	.0597
Birmingham, 55% asphalt	.0475	.0475
Dallas, 45% asphalt	.0495	.0495
Dallas, 55% asphalt	.0455	.0455
Dallas, binder	.061	.061
San Francisco, binder, per ton	12.00*	12.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)	$23.00	$18.50
Boston (*Mexican*)	22.50	18.50
Chicago (*Texas*)	27.00	23.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	18.00	12.00
Dallas (*Texas*)	27.10	21.10
Seattle, *"D" grade, California, f.o.b. Richmond*	19.50	13.50
Denver (*California*)	24.00	.....
Minneapolis, *f.o.b. Twin Cities (Standard)*	27.60	21.60
St. Louis (*Mexican*)	25.00	22.00
Baltimore (*Mexican*) (*f.o.b. refinery*)	22.50	18.50
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	24.60	20.40
Detroit (*Mexican*)	26.90	22.90
Cincinnati (*Kentucky Rock*)	.....	11.65
Maurer, N. J. (*Bermuda*)	30.00	.....
Maurer, N. J. (*Trinidad*)	23.00	.....
Philadelphia (*Mexican*)	20.00	18.00
Kansas City, Mo. (*Texas*)	*22.50*	19.00
Los Angeles (*"D" grade, California*)	*18.00	*12.00
Birmingham (*Mexican*)	27.00	21.00
New Orleans (*Mexican*)	26.00	17.00

* F.o.b. El Segundo Refinery. Drums used in New York.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd.	$147.00 per M.
San Francisco	Basalt block 4x7x8	70.00 per M.
Chicago	about 5x8x5 dressed	3.60 per sq.yd.
	about 5x8x5 common	3.25 per sq.yd.
Boston	5-in. Granite	135.00 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	3.18 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	Granite, 4x8x4	1.65 per sq.yd.
Kansas City	Granite	3.25 per sq.yd.
Philadelphia	Granite	3.90@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.24 per sq.ft.
	Manhattan, 4 ft. wide	.24 per sq.ft.
	Queens, 5 ft. wide	.26 per sq.ft.
	6x24-in. cross-walk	1.30 per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., 88c.; *St. Louis*: Class "A" straight, delivered, 5x18 in., $1.05 per lin.ft.; roundings, $1.60. *Birmingham*: Limestone, 5x18-in., $1.05 per lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3	16	$2.40
New York	3½	16	2.70
Boston	3½	18	2.50
Chicago	4	16	2.25
Chicago	3½	16	2.10
St. Louis	3½	16	2.45
St. Louis	4	16	2.75
Seattle	4	16	Off market
Minneapolis	3½	16	*2.40*
Atlanta	3½	16	2.00
New Orleans	3	16	2.20
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Detroit	4	16	.....
Cincinnati	3½	16	2.35
Kansas City	4	16	2.50
Philadelphia	4	16	None used

Construction Materials

SAND AND GRAVEL—Price for cargo or carload lots to contractor f.o.b., per cu.yd. is as follows:

	Gravel 1½ In. Mar. 4	Gravel 1½ In. One Year Ago	Gravel ¾ In. Mar. 4	Gravel ¾ In. One Year Ago	Sand Mar. 4	Sand One Year Ago
New York (*alongside dock*)	$1.75	$1.75	$1.75	$1.75	$1.00	$1.25
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	1.65	.....	1.65	.....	1.50	.....
St. Louis	1.45	1.45	1.45	1.45	1.08	1.18
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas	2.38	2.38	2.38	2.38	2.00	2.00
Minneapolis	1.65*	1.65*	1.65*	1.65*	1.25	1.25
Cincinnati	1.40†	1.40†	1.40†	1.40	1.35†	1.35†
San Francisco	*1.80*	2.15	*1.80*	2.15	*1.40*	1.50
Boston	1.50†	1.50†	1.50†	1.50†	1.00†	1.00†
New Orleans	2.60	2.63	2.60	2.63	1.75	1.75
Los Angeles	1.15†	1.35†	1.15†	1.40†	.90*†	.90*†
Atlanta	1.90†	1.90†	1.90†	1.90†	1.50†	1.40†
Detroit	2.02	2.02	2.02	2.02	1.62	1.62
Baltimore	1.40	1.40	1.60	1.60	.70*†	.70*†
Montreal	1.25†	1.25†	1.25†	1.25†	1.25†	1.25†
Birmingham	2.00	2.00	2.00	2.00	1.50	1.45†
Philadelphia	2.10	2.10	2.10	2.10	1.50	1.50
Kansas City	4.00‡	4.00‡	4.00‡	4.00‡	.66*†	.66*†

New York—Grits, $1.75 per cu.yd.; ready mixed $1.85.
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit. † Per ton. ‡ Joplin chats.

CRUSHED STONE—Price for cargo or carload lots, per cu.yd. f.o.b. city, is as follows:

	1½ In. Mar. 4	1½ In. One Year Ago	¾ In. Mar. 4	¾ In. One Year Ago
New York	$1.75	$1.75	$1.85	$1.85
Chicago	1.75	.....	1.87½	.....
St. Louis	1.93*	1.75*	1.93*	1.75*
Dallas	2.40	2.40	2.83	2.83
San Francisco	*1.70*	2.15	*1.70*	2.15
Boston	1.60*	1.60*	1.60*	1.60*
Minneapolis	1.75	1.75	1.75	1.75
Kansas City	1.50	1.50	1.50	1.50
Denver	2.50	2.50	2.50	2.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.50*	2.00*	2.50*	2.00*
Cincinnati	1.90*	1.90*	1.90*	1.90*
Los Angeles	1.40*	1.45*	1.40*	1.55*
Detroit	2.00*	1.70	2.00*	1.70
Baltimore	2.50	2.50	2.55	2.55
Montreal	1.80*	2.25*	1.50*	2.25*
Philadelphia	2.10	2.10	2.10	2.10
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*
Birmingham	2.00	2.00	2.00	2.00

* Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plant

	1½-In	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.25	1.30	2.00	1.30
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.	.....	.....	2.50	.....
Birmingham, Ala.	.80@.90	1.15	2.05	.....
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.80	1.80	.....	1.75
Eastern Pa. and Northern N. J.	1.25	1.25	2.50	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	.....
Toledo, Ohio	1.25	1.25	1.50	1.25

LIME—Warehouse prices:

	Hydrated, per Ton— Finishing	Hydrated, per Ton— Common	Lump, per Barrel— Finishing	Lump, per Barrel— Common
New York	$18.20	$12.00@$13.10	$3.50*	$2.25@2.75*
Chicago	20.00	18.00	.....	2.25*
St. Louis	24.00	20.00	.....	15.00‡
Boston	20.00	13.50@14.50	3.75*	3.00*
Dallas	20.00	.....	.....	1.85†
Cincinnati	16.80	14.30	.....	13.40‡
San Francisco	22.00	.....	.....	1.60†
Minneapolis	25.50	21.00	1.60@1.70† (brown)	1.35†
Denver	24.00	.....	.....	2.70*
Detroit	15.50	12.50	.....	16.00‡
Seattle, *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	20.00	18.00	3.50*	19.50‡
Baltimore	24.25	17.85	2.55†	.....
Montreal	.....	21.00	.....	10.00‡
Atlanta	22.50	13.00	2.20†	1.50†
New Orleans	24.00	16.00	2.50†	2.00*
Philadelphia	23.00	16.00	.....	.....
Kansas City	17.50	*15.00*	1.40†	1.32†
Birmingham	22.50	16.00	2.40†	1.85†

* Per 280-lb. bbl. (net). † Per 180-lb. (net). ‡ Per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, exclusive of bags:

	Mar. 4	One Month Ago	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80	$2.80
Kansas City (Ft. Scott)	1.45	1.50	1.50
Cincinnati (Utica)	1.72	1.72	1.72
Boston (Rosendale)	2.65	2.50	2.50
St. Louis (Carney)	2.35	2.35	2.35
Birmingham (Magnolia) pozzolan cement	2.40	2.40	2.40

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Mar. 4	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.70	$2.50@2.70	$2.50@2.60
New York, alongside dock to dealers	2.15	2.15	2.15
Jersey City	2.33	2.33	2.33
Boston	2.40	2.40	2.55
Chicago	2.10	2.10	2.20
Pittsburgh	2.09	2.09	2.19
Cleveland	2.29	2.29	2.39
Detroit	2.15	2.15	2.35
Indianapolis	2.29	2.29	2.41
Milwaukee	2.25	2.25	2.35
Duluth	2.09	2.09	2.19
Peoria	2.27	2.27	2.37
Cedar Rapids	2.34	2.34	2.44
Davenport	2.29	2.29	2.39
St. Louis	2.20	2.20	2.30
San Francisco	2.31	2.31	2.61
New Orleans	2.40	2.40	2.40
Minneapolis	2.32	2.32	2.42
Denver	2.84	2.84	2.84
Seattle	2.65	2.65	2.65
Dallas	2.05	2.05	2.05
Atlanta	2.35	2.30	2.30
Cincinnati	2.37	2.37	2.47
Los Angeles	2.52	2.52	2.80
Baltimore	2.35	2.35	2.50
Birmingham	2.40	2.40	2.40
Kansas City, Mo.	2.35	2.02	2.07
Montreal	1.80	1.80	1.80
Philadelphia	2.41	2.41	2.41
St. Paul	2.32	2.32	2.42
Toledo	2.20	2.20	2.40

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.85	Hudson, N. Y.	$2.05
Universal, Pa.	1.85	Leeds, Ala.	1.95
Steelton, Minn.	1.90	Hannibal, Mo.	1.95
Fordwick, Va.	2.05	Lehigh Valley District	1.95
Mitchell, Ind.	1.95	Wyandotte, Mich.	1.80
Iola, Kan.	1.85	Alpena, Mich.	1.75
Mason City, Ia.	1.90	Richard City, Tenn.	2.05
La Salle, Ill.	1.95	Kingsport, Tenn.	2.05

E. N.-R. Prices of Construction Materials

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.97	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.23	1.29	1.76	1.35	1.38	1.55
068	35	1.51	1.58	2.16	1.66	1.67	1.91
093	45	1.94	2.03	2.77	2.13	2.00	2.46
126	57	2.39	2.51	3.45	2.63	2.55	3.03
153	68	2.86	2.99	4.11	3.14	3.15	.....
180	78	3.28	3.43	5.70	3.60	3.47	.....
245	103	4.33	4.53	6.21	4.75	4.58	.....
287	119	5.00	5.24	7.19	5.50	5.26	6.35
336	138	5.80	6.07	8.35	6.37	6.11	.....
395	160	6.72	7.04	9.65	7.38	7.12	.....
PAVING							
036P	17	$0.74	$0.77	$1.06	$0.81	$0.76	.....
053P	24	1.04	1.09	1.50	1.14	1.07	.....
072P	31	1.32	1.38	1.90	1.45	1.39	.....
097P	40	1.70	1.78	2.45	1.87	1.90	.....
049R	24	1.04	1.09	.....	1.14	1.07	.....
067R	31	1.32	1.38	.....	1.45	1.39	.....
089R	40	1.70	1.78	.....	1.87	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted:

Weight in pounds	New York	Birmingham	Chicago	St. Louis	San Francisco	Dallas
2.2	$19.00	$22.00	$19.00	$19.00	$19.00	$23.50
2.5	21.00	23.00	21.00	21.00	21.00	25.00
3.0	24.00	26.00	24.00	24.50	23.50	28.50
3.4	26.00	28.00	26.00	26.50	25.50	31.00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$2.00	$2.25	$3.24	$3.00	$3.15	$3.38	$3.10
⅝	2.10	2.35	3.34	3.10	3.25	3.43	3.20
¾	2.20	2.45	3.44	3.20	3.35	3.48	3.30
⅞	2.40	2.65	3.64	3.40	3.55	3.63	3.50
1	3.00	3.25	4.24	4.00	4.15	3.78	4.10

For standard classification of extras for size and cutting of steel bars, see bar card of July 15, 1923.

ROLLED FROM RAILS

	St. Louis	Dallas		St. Louis	Dallas
½ and larger	$2.55	$2.80	⅝	$2.95	$3.02
¾ in.	2.65	2.85	1	3.55	3.20
⅞	2.67	2.90		.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Mar. 4	Common: One Month Ago	Common: One Year Ago	Paving Block: 3-inch*	Paving Block: 3½-inch*
New York (del.)	$21.00	$20.40	$18.00	$45.00	$51.00
New York (at dock)	17.75	17.25	15.00	.....	.....
Chicago	12.00	12.00	12.00	42.00	45.00
St. Louis, salmon (del.)	16.00	16.00	16.00	40.00	42.50
Denver, salmon	12.00	12.00	12.00	.....	.....
Dallas	11.10	10.50	12.10	35.00	.....
San Francisco	15.50	15.50	15.50	.....	.....
Los Angeles	11.50	11.50	13.00	(not used)	
Boston (del.)	17.50	17.50	19.00	45.00	50.00
Minneapolis (del.)	13.50	13.50	13.50	.....	.....
Kansas City	14.50	14.50	14.50	(no market)	
Seattle	15.00	15.00	14.50	.....	42.50
Cincinnati	17.00	17.00	17.00	40.00	45.00
Montreal	17.50	17.50	17.50	100.00†	68.00
Detroit (del.)	16.00	16.00	17.50	37.50	40.50
Baltimore	18.00	18.00	18.00	40.00	45.00
Atlanta	10.50	10.50	10.50	40.00	.....
New Orleans	15.00	15.00	15.00	.....	.....
Birmingham	12.50	12.50	12.50	40.00	45.00
Philadelphia	17@21	17@20	19.00	40.00	50.00
Pittsburgh (del.)	16.00	16.00	16.00	.....	.....
Cleveland	14.00	14.00	14@16	.....	.....

*For paving blocks 3x8½x4 and 3½x8½x4 respectively. †Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Mar. 4 on Trucks*†	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco†	Perth Amboy N. J. Factory*
4x12x12	$0.1112	$0.1162	$0.075	$0.12	$0.07	$0.108	.....
6x12x12	.1667	.1743	.096	.....	.094	.156	.....
8x12x12	.2084	.2179	.135	.22	.128	.244	.....
10x12x12	.....	.....	.167	.....	.155	.....	$0.252
12x12x12	.....	.....	.215	.....	.185	.....	.312

*5 per cent off for cash. †Partition tile.

	4x12x12	8x12x12	12x12x12
Boston	$0.085	$0.17	.....
Minneapolis (f.o.b. cars)	.0636	.106	$0.189
Minneapolis (delivered)	.07	.116	.205
Cincinnati	.07485	.13745	.....
Kansas City	.086	.11	.145
Denver	.075	.155	.188
Seattle (delivered)	.10	.20	.30
Los Angeles	.085	.172	.....
New Orleans	.13	.20	.....
Detroit (delivered)	.095	.165	.2821
Montreal	.12	.....	.....
Baltimore	.125	.27	.....
Atlanta	.0977	.1837	.....
Dallas	.10	.19	.275
Birmingham	.11	.1824	.255
Pittsburgh (delivered)	.068	.128	.179
Cleveland	.07	.149	.....

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh Mill	Birmingham	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$1.90@2.00	$2.05	$3.34	$4.15	$3.25	$3.10	$3.30
Channels, 3 to 15 in.	1.90@2.00	2.10	3.34	4.15	3.25	3.10	3.30
Angles, 3 to 16 in., ¼ in. thick	1.90@2.00	2.10	3.34	4.15	3.25	3.10	3.30
Tees, 3 in. and larger	1.90@2.00	2.10	3.34	4.15	3.35	3.10	3.30
Plates, ¼ in. thick and heavier	1.80	2.00	3.34	4.15	3.25	3.10	3.30

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York, Mar. 4	New York, One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in.	$2.50@2.60	$4.50	$4.25	$3.50	$3.65	$5.00	$4.75
CONE HEAD BOILER							
½ in.	2.90	$4.70	$4.35	$3.70	$3.85	$5.20	$5.00
⅝ and ¾	3.05	4.85	4.50	3.80	4.20@4.45	5.35	5.15
⅞ and 1	3.30	5.10	4.75	4.05	4.60	5.60	5.50

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.65	$2.85	$3.15	$3.50	$4.28	$2.93	$4.95
Cut	2.80	2.90	....	5.30	5.00	3.15	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
½	$7.50	$5.75	$7.75
⅝	7.05	5.30	5.65
¾	6.90	5.15	5.50

Pittsburgh base in lots of 200 kegs or more, $3.25.

PREPARED ROOFINGS—Slate-surfaced roofing in rolls of 108 sq.ft. costs $2.35@$2.50 per roll to contractors in carload lots f.o.b. New York.

Single shingles, slate finish, cost $7.00 per square (sufficient to cover 100 sq.ft.) in carload lots, f.o.b. New York. Strip shingles (4 in 1) f.o.b. New York, in carload lots to contractors, $5.00 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to contractors in carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton	$70.00
Asphalt roofing (in barrels) per ton	25.00
Asphalt felt, per ton	72.00

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 83 per cent; "A," 87 per cent; "B," 89 per cent. Double thickness "AA," 82 per cent; "A," 86 per cent; "B," 89 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	2.45@2.50	$3.60	$3.50	$3.75	$3.89
No. 12	2.50@2.55	3.65	3.55	3.80	3.94
No. 14	2.55@2.60	3.70	3.60	3.85	3.99
No. 16	2.65@2.70	3.80	3.70	3.95	4.09
Black					
*Nos. 18 to 20	3.05@3.15	4.40	3.90	4.55	4.30
*Nos. 22 to 24	3.10@3.20	4.45	3.95	4.60	4.35
*Nos. 26 and 27	3.15@3.25	4.50	4.00	4.70	4.40
*No. 28	3.25@3.35	.60	4.10	4.80	4.50
Galvanized					
No. 10	3.50@3.60	4.70	4.25	5.00	4.50
Nos. 12 to 14	3.60@3.70	4.80	4.35	5.10	4.60
No. 16	3.75@3.85	....	4.50	5.25	4.75
Nos. 18 to 20	3.90@4.00	5.10	4.65	5.40	4.90
Nos. 22 to 24	4.05@4.15	5.25	4.80	5.55	5.05
*Nos. 26 and 27	4.20@4.30	5.40	4.95	5.70	5.20
*No. 28	4.50@4.60	5.70	5.25	6.00	5.50

* For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Mar. 4	New York: One Year Ago	Chicago: Mar. 4	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	$0.87	$1.21	$0.88	$1.25

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—Per 100-lb. keg, base price f.o.b. New York:

	Dry		In Oil	
	Mar. 4	1 Yr. Ago	Mar. 4	1 Yr. Ago
Red	$15.25	$16.25	$16.75	$17.75
White	15.25	16.25	15.25	16.25

Lumber

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$26 00	$27 00	$28 00	$31 00
3x6 and 8	26 00	27 00	28 00	31 00
4x4-6 and 8	26 00	27 00	28 00	31 00
3x10 and 12	26 00	27 00	28 00	31 00
3x14	30 00	30 00	32 00	34 00
4x10 and 12	26 00	27 00	28 00	31 00
4x14	30 00	30 00	32 00	34 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$28 00	$30 00	$32 00
6x14	34 00	36 00	38 00
8x10	28 00	30 00	32 00
8x14	34 00	36 00	38 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	**$48 00**	**49 00**	$42 00	$43.00
3x10 to 10x10	**53 00**	**54 00**	47 50	48 50
3x12 to 12x12	**58 00**	**59 00**	57 50	58 50
3x14 to 14x14	**62 00**	**63 00**	68 50	69 50
3x16 to 16x16	**68 00**	**69 00**	75.50	76 50

New York—Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $50; $10 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 32 ft. for sizes 12x12 and under; for sizes over 12x12 add $2; for merchantable add $2 to sizes 10x10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$51.00	$48.00†	$51.00	$50.00	$61.00	$58.00†
Seattle	.....	**24 00**	.....	.....	.....	25.00
New Orleans	37.00	.....	.....	.....	45 00	.....
Baltimore	32.50	49.25	53.00	60.00	38.00	49.75
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Montreal	50.00	58.00	.....	.....	**65 00**	65.00
Los Angeles	.....	37.00	.....	.....	.....	38.00
Denver	.....	**34.75**	**34.75**	**34.75**	.....	*44.75*
Minneapolis	42.00	37.75	35.00	.....	*44.00*	**37.75**
Atlanta	31.00	.....	.....	.....	34.00	.....
Dallas	56.00	.....	.....	.....	56.00	.....
Kansas City, Mo.	44.50	40.75	.....	.....	59.50	**41.75**
Birmingham	32.00	.....	.....	.....	34.00	.....
Philadelphia	54.00	**37.00**	**38.00**	**45.00**	65.00	**37.00**
Detroit	47.75	46.75	.....	.....	61.75	46.75
St. Louis	**42.25**	.....	.....	.....	**55.25**	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	$46.00	$42.00†	$45.00	$51.00	$48.00†
Seattle	.....	20.00	.....	.....	**24.00**
New Orleans	75.00	.....	.....	40.00	.....
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	**70.00**	79.00	75.00	38.00	85.00
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles	.....	37.00	.....	.....	.....
Denver	.....	*33.25*	**31.25**	.....	32.25
Minneapolis	42.50	35.75	34.75	*37.00*	34.25
Atlanta	22.00	.....	.....	28.00	.....
Dallas	*52.00*	.....	.....	56.00	.....
Kansas City, Mo.	*50.25*	**41.75**	.....	**40.25**	35.75
Birmingham	**27.00**	.....	.....	42.00	.....
Philadelphia	*33.00*	**35.00**	36.00	52.00	34.00
Detroit	39.75	37.00	.....	46.50	41.25
St. Louis	41.00	.....	.....	30.00	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M. ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $2 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.
*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

Miscellaneous

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Mar. 4	One Month Ago	One Year Ago
$2.25@2.30	$2.25@$2.30	$2.15@2.25

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅜-in., 8 ft.; ½-in., 6; ⅝-in., 4½; ¾-in., 3½; 1-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.19@.25	New Orleans	$0.25½
New York	.27	Los Angeles	.25
Chicago	.25½	Seattle	.24
Minneapolis	.27½	St. Louis	.25½
San Francisco	.25	Montreal	.16
Atlanta	.27	Detroit	**.27**
Denver	.26@28	Baltimore	.18
Cincinnati	.21	Kansas City	.28
Dallas	.31	Birmingham	*.26@.27*
Philadelphia	.26		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.265*	$0.2875
Boston	.225	.25
Kansas City	*.20*	*.22*
Seattle	.165	.19
Chicago	.215*	.2375*
Minneapolis	.1917	.2123
St. Louis	.2275	.2525
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1875	.2125
Atlanta	.215	.24
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.195	.235
Birmingham	.22	.24
New Orleans	.233	.26
San Francisco	.1625	.1925
Philadelphia	.215	.24

*Special gelatan.

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f.o.b. works:

Sulphate of aluminum, in bags, per 100 lb.	$1.40@$1.45
Sulphate of copper, in bbl., per 100 lb.	4.60
Soda ash, 58%, in bags, per 100 lb.	1.38
Chlorine, liquid, tanks, per lb.	.04@.04½
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.00@2.10

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.735
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.29	St. Louis	.43
Cleveland	.19	St. Paul	.60
Denver	1.15*		

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.